JPRS-EST-89-033
27 DECEMBER 1989

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# JPRS Report

# Science & Technology

## Europe

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# Science & Technology
## Europe

JPRS-EST-89-033 26 DECEMBER 1989

CONTENTS

## FRG: 1990 BMFT Budget Presented

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[Excerpt]

### Draft Federal Budget For 1990—Individual Budget 30

### Area Within the Jurisdiction of the Federal Ministry of Research and Technology

Within the framework of matters for which the federal government is responsible, the area within the jurisdiction of the federal minister of research and technology includes the following sectors:

- Research funding on a general basis and funding of basic research, with the exclusion of the German Research Association and special research programs;
- Funding of innovative programs; research planning and coordination, as well as assessment of the consequences of technology;
- Funding of research and development in the natural sciences, with the primary goals of increasing the international competitiveness of industry, securing raw material supplies including water technology and environmental protection, as well as funding medical, health, biotechnology, climatology, and civil engineering research, and research aimed at improving working conditions;
- Basic and coordination issues involved in communications technology;
- Funding of computer science, electronics, and information and documentation systems; coordination of data processing systems;
- Matters concerning nuclear research and nuclear engineering for nonmilitary purposes, reactor safety research; nonnuclear energy research and technology;
- Funding of space, marine, and polar research, as well as research and development in the area of surface transport and traffic; funding of aeronautical research in fields within the jurisdiction of the federal minister of research and technology; coordination of civilian and military aerospace research and development.

Research and development funding also extends to measures taken to apply research and development results, with a view toward acquiring experience relevant to research and development ranging from prototype and demonstration plants or projects (innovative), to the study of R&D aspects of technical regulations, specifications, and standards, to the involvement of young scientists in key technologies at selected national and foreign research institutes, to international cooperation and technology transfer projects in developing countries, and to projects involving technological cooperation pursuant to decisions made by the Council of the European Communities. The financial resources budgeted for project funding can also be used to carry out preliminary and accompanying studies and technical reports, as well as the exchange of scientific findings at the international level. The award of subsidies to industry is conditional upon adequate financial participation by the company concerned, which as a rule is set at 50 percent. [passage omitted]

**3002 General Research Funding**

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 526 02-179 | Funding for assessment of the consequences of technology and for research planning | 8,500 | 6,400 | 6,149 |
| 531 02-179 | Subsidies for fairs and exhibitions in the FRG and abroad | 2,425 | 2,500 | 2,624 |
| 531 04-169 | Information on research and technology | 1,490 | 1,500 | 2,050 |
| 532 02-179 | Competitions and prizes to promote research and innovation | 330 | 330 | 312 |
| 681 05-179 | Grants to promote exchanges between scientists | 17,000 | 16,500 | 16,147 |
| 685 02-179 | Grants to selected researchers and research teams | 11,250 | 9,000 | 6,750 |
| 685 62-179 | Subsidy to the Scientific Film Institute (IWF), in Goettingen | 4,905 | 4,808 | 4,685 |
| 686 30-169 | Funding of cooperation with other countries and between the two Germanies on scientific research and technological development | 18,300 | 15,070 | 14,245 |
| Tgr.01 | Humanities and social sciences | (67,818) | (63,328) | (56,757) |
| 652 55-179 | Subsidy for the Academies of Science Program | 17,000 | 16,650 | 16,238 |
| 685 05-179 | Funding of peace and conflict research | 3,300 | 3,400 | 2,895 |
| 685 06-175 | Funding of social science research | 5,600 | 5,711 | 5,650 |
| 685 07-175 | Association of Social Science Infrastructure Institutions (GESIS) in Mannheim | 10,595 | 9,260 | 8,810 |
| 685 58-179 | Institutional funding of humanities institutes | 21,840 | 19,711 | 15,205 |
| 685 61-179 | Funding of humanities projects | 5,500 | 4,725 | 4,380 |

### 3002 General Research Funding (Continued)

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 685 98-179 | Subsidies to the German Contemporary History Society in Erlangen, and to the Institute for Society and Science, Erlangen | 2,953 | 2,841 | 2,605 |
| 686 60-179 | Contributions to the International Institute of Applied Systems Analysis (IIASA) in Vienna | 1,030 | 1,030 | 974 |
| Tgr.02 | General funding for innovations achieved by small and medium-sized firms | (166,500) | (188,000) | (208,178) |
| 683 01-171 | Funding of contract research and development commissioned by industrial firms | 39,000 | 58,000 | 67,332 |
| 683 03-169 | Research cooperation between science and industry | 21,000 | 21,000 | 20,808 |
| 683 04-171 | Grants designed to increase industrial research and development capacity | 60,000 | 55,000 | 68,468 |
| 683 29-171 | Financial share in the innovation risk of new technology-oriented firms | 46,500 | 50,000 | 45,886 |
| Tgr.03 | Max Planck Society for Support of the Sciences (MPG) in Goettingen | (472,335) | (457,365) | (440,901) |
| 685 52-161 | Operating expenses | 406,845 | 393,190 | 379,335 |
| 893 52-161 | Investments | 65,490 | 64,175 | 61,566 |
| Tgr.04 | Fraunhofer Society for Support of Applied Research (FhG) in Munich | (164,497) | (153,063) | (146,580) |
| 685 56-161 | Operating expenses | 92,100 | 84,485 | 76,818 |
| 893 56-161 | Investments | 73,955 | 70,136 | 67,284 |
| 980 56-990 | Expense reduction due to reimbursements from the food, agriculture, and forestry budget | -1,558 | -1,558 | -1,520 |
| Tgr.05 | Berlin Scientific Center for Social Research (WZB) | (13,656) | (13,775) | (18,062) |
| 685 57-175 | Operating expenses | 13,656 | 13,461 | 13,635 |
| 893 57-175 | Investments | | 314 | 4,427 |

### 3003 Natural Science Principles, Living Conditions

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 652 50-179 | Allocations to the Kiepenheuer Institute of Solar Physics in Freiburg | 2,273 | 2,101 | 2,197 |
| 683 19-175 | Funding of research and development to improve working conditions | 97,500 | 95,000 | 91,816 |
| 683 21-169 | Geosciences and mining engineering | 61,000 | 48,000 | 46,237 |
| 685 23-175 | Research and development projects in health services, medical research, and medical technology | 160,000 | 148,000 | 125,472 |
| 685 51-169 | Subsidy to the Institute of Spectrochemistry and Applied Spectroscopy (ISAS) in Dortmund | 5,631 | 5,247 | 4,970 |
| Tgr.01 | Construction research and engineering (Expenses up to DM3 million can be reciprocally covered) | (40,000) | (40,275) | (32,990) |
| 683 17-176 | Research and development projects | 36,000 | 35,775 | 30,359 |
| 892 17-176 | Investment subsidies | 4,000 | 4,500 | 2,631 |
| Tgr.02 | Funding of ecology and climatology | (256,900) | (242,300) | (202,681) |
| 683 24-169 | Research and development projects | 195,600 | 182,300 | 127,796 |
| 892 24-169 | Investment subsidies | 61,300 | 60,000 | 51,000 |
| Tgr.03 | Funding of selected priority areas in basic natural science research (Expenses up to DM5 million can be reciprocally covered) | (126,000) | (144,054) | (126,958) |
| | Expenses can be reciprocally covered up to DM5 million | | | |
| 685 01-165 | Projects | 81,000 | 80,400 | 70,116 |
| 893 01-165 | Investments | 45,000 | 63,654 | 56,842 |

### 3003 Natural Science Principles, Living Conditions (Continued)

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| Tgr.04 | Senckenberg Research Institute, at the Senckenberg Nature Research Association in Frankfurt | (6,713) | (6,602) | (182,300) |
| 685 50-163 | Operating expenses | 5,598 | 5,437 | 5,393 |
| 893 50-163 | Investment | 1,115 | 1,165 | 575 |
| Tgr.05 | German Cancer Research Center (DKFZ) Foundation in Heidelberg | (122,528) | (117,733) | (110,395) |
| 685 55-175 | Operating expenses | 90,528 | 87,133 | 84,205 |
| 893 55-175 | Investment | 32,000 | 30,600 | 26,190 |
| Tgr.06 | German Primate Center (DPZ) in Goettingen | (4,853) | (4,117) | (-) |
| 685 59-175 | Operating expenses | 4,853 | 4,117 | |
| 893 59-175 | Investments | | | |
| Tgr.07 | German Electron-Synchrotron (DESY) Foundation in Hamburg | (215,284) | (252,976) | (256,617) |
| 685 60-165 | Operating expenses | 148,134 | 127,483 | 90,592 |
| 893 60-165 | Investments | 67,150 | 125,493 | 166,025 |
| Tgr.08 | Society for Heavy Ion Research (GSI) in Darmstadt | (112,064) | (145,080) | (117,107) |
| 685 61-165 | Operating expenses | 76,365 | 64,780 | 60,507 |
| 893 61-165 | Investments | 35,699 | 80,300 | 56,600 |
| Tgr.09 | Hahn Meitner Institute (HMI) in Berlin (Expenses up to DM2.19 million can be reciprocally covered) | (92,082) | 94,410) | (90,348) |
| 685 62-165 | Operating expenses | 67,082 | 63,900 | 57,498 |
| 893 62-165 | Investments | 25,000 | 30,510 | 32,850 |
| Tgr.10 | Radiation and Environmental Research Society (GSF) in Munich | (132,000) | (120,840) | (118,528) |
| 685 63-173 | Operating expenses | 102,000 | 98,800 | 93,366 |
| 893 63-173 | Investments | 30,000 | 22,040 | 25,162 |
| Tgr.11 | International cooperation in the field of basic natural sciences | (348,630) | (302,746) | (298,193) |
| 686 01-165 | Contributions to the European Organization for Nuclear Research (CERN) in Geneva | 230,000 | 223,553 | 226,512 |
| 686 03-179 | Contributions to the European Organization for Astronomical Research in the Southern Hemisphere (ESO) in Garching, near Munich | 20,130 | 18,300 | 13,347 |
| 686 08-169 | German-Israeli Foundation for the Promotion of Research and Development | 10,000 | 20,000 | 20,000 |
| 686 09-179 | Funding of scientific cooperation with foreign research institutes | 13,500 | 13,000 | 12,400 |
| 686 50-165 | Contributions to the Max von Laue-Paul Langevin Institute (ILL) in Grenoble (very-high flux research reactor) | 27,000 | 27,893 | 25,934 |
| 686 51-169 | Contributions to the European Synchrotron Radiation Facility (ESFR) in Grenoble | 28,000 | | |
| 686 52-022 | Contributions to the Petten high flux research reactor under the European Communities complementary program | 20,000 | | |

### 3004 Computer Science, Manufacturing Engineering, Specialized Information

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 683 23-169 | Funding of manufacturing engineering research and development | 107,000 | 115,000 | 103,300 |
| 683 41-172 | Funding of technical communications research and development | 93,000 | 95,000 | 110,000 |
| 683 42-168 | Funding of computer science research and development | 93,000 | 104,000 | 118,196 |
| Tgr.01 | Funding of electronics research and development | (281,000) | (261,000) | (258,350) |
| 683 40-169 | Research and development projects | 151,000 | 150,200 | 157,821 |

**3004 Computer Science, Manufacturing Engineering, Specialized Information (Continued)**

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 683 46-169 | Funding of microperipherals/microsystems technology research and development | 94,000 | 74,800 | 76,529 |
| 892 40-169 | Investment subsidies | 36,000 | 36,000 | 24,000 |
| Trg.02 | Mathematics and Data Processing Society (GMD) in Bonn | (109,935) | (100,081) | (92,335) |
| 685 50-168 | Operating expenses | 84,105 | 80,929 | 74,654 |
| 893 50-168 | Investments | 25,830 | 19,152 | 17,681 |
| Tgr.03 | Heinrich Hertz Institute for Communications Technology (HHI) in Berlin | (13,781) | (13,317) | (12,247) |
| 685 59-172 | Operating expenses | 10,281 | 9,817 | 8,247 |
| 893 59-172 | Investments | 3,500 | 3,500 | 4,000 |
| Tgr.04 | Specialized information; funding of information services as well as research and development | (41,500) | (44,000) | (53,414) |
| 685 60-162 | Funding of individual projects | 36,000 | 39,000 | 47,976 |
| 893 60-162 | Investment | 5,500 | 5,000 | 5,438 |
| Tgr.05 | Institutional funding of interregional information centers | (37,930) | (36,997) | (34,752) |
| 685 61-162 | Building and operating expenses | 30,883 | 30,451 | 31,307 |
| 893 61-162 | Investment | 7,047 | 6,546 | 3,445 |
| Tgr.06 | Information and Documentation Society (GID) in Frankfurt | (1,575) | (2,000) | (2,735) |
| 685 96-162 | Operating expenses | 1,575 | 2,000 | 2,735 |
| 893 96-162 | Investment | | | |

**3005 Energy Research and Technology**

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 683 15-621 | Federal government participation in nuclear energy risk | 20,000 | 20,000 | 50,000 |
| 683 26-621 | Funding of nuclear fuel procurement (including uranium enrichment | 2,500 | 2,500 | 10,939 |
| 685 07-173 | Funding of research on reactor safety and general safety technology in nuclear research and nuclear technology | 105,000 | 104,000 | 97,685 |
| 686 05-621 | Contributions to the International Atomic Energy Organization (IAEO) in Vienna | 32,611 | 32,248 | 29,113 |
| 686 22-621 | Contribution to the costs of the European Association for the Chemical Reprocessing of Nuclear Fuels Exposed to Radiation (Eurochemic) in Mol | 7,600 | 8,939 | 7,241 |
| Tgr.01 | Funding of nonnuclear energy research and technology | (396,000) | (413,500) | (371,121) |
| 683 13-166 | Research and development in the area of rational energy exploitation and new energy sources | 102,000 | 92,000 | 74,389 |
| 683 16-166 | Research and development of coal technology and other fossile energy sources; power station engineering | 40,000 | 46,000 | 63,830 |
| 892 13-166 | Investment for rational energy exploitation and new energy sources | 153,000 | 157,000 | 107,102 |
| 892 16-166 | Investment in coal technology and other fossile energy sources; power station engineering | 76,000 | 84,500 | 85,400 |
| 892 18-166 | Development of coal upgrading plants | 25,000 | 34,000 | 40,400 |
| Tgr.02 | Funding of reactor development | (112,000) | (119,000) | (133,461) |
| 683 12-165 | Research and development work on the further development of high temperature reactors | 30,000 | 31,000 | 31,300 |
| 683 19-165 | Joint use of a research reactor with low-enrichment fuel and development of a heat reactor, as well as designs for the development of other reactors | 3,000 | 1,000 | 1,000 |
| 892 11-165 | Development of fast-breeder reactors | 79,000 | 87,000 | 101,161 |

**3005 Energy Research and Technology (Continued)**

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| Tgr.03 | Nuclear waste disposal | (69,000) | (94,000) | (89,279) |
| 683 27-165 | Funding of research and development | 43,000 | 55,900 | 48,920 |
| 893 27-165 | Investments | 26,000 | 38,100 | 40,359 |
| Tgr.04 | Karlsruhe Nuclear Research Center (KfK) (Expenses up to DM7.6 million can be reciprocally covered) | (461,808) | (447,264 | (442,889) |
| 685 50-165 | Operating expenses | 385,808 | 369,264 | 352,639 |
| 893 50-165 | Investments | 76,000 | 78,000 | 90,250 |
| Tgr.05 | Juelich Nuclear Research Facility (KFA) in Juelich (Expenses up to DM8.310 million can be reciprocally covered) | (437,159) | (437,022) | (412,008) |
| | Expenses can be reciprocally covered up to DM8.310 million | | | |
| 685 55-165 | Operating expenses | 354,059 | 352,422 | 333,114 |
| 893 55-165 | Investments | 83,100 | 84,600 | 78,894 |
| Tgr.06 | Max Planck Institute for Plasma Physics (IPP) in Garching, near Munich | (85,880) | (85,290) | (89,797) |
| 685 62-165 | Operating expenses | 61,500 | 59,640 | 55,727 |
| 893 62-165 | Investments | 24,380 | 25,650 | 34,070 |
| Tgr.07 | GKSS [Society for Nuclear Energy Exploitation in Naval Engineering and Navigation] Geesthacht Research Center in Geesthacht | (87,976) | (87,197) | (81,540) |
| 685 65-165 | Operating expenses | 68,456 | 69,692 | 63,412 |
| 893 65-165 | Investments | 19,520 | 17,505 | 18,128 |

**3006 Space Research and Engineering, Aeronautical Research**

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 683 05-167 | Basic studies and technologies for the space research and engineering funding program | 27,000 | 21,500 | 14,200 |
| 685 09-167 | Subsidy for the operation of test facilities and earthbound operational facilities for space projects, as well as reimbursement of costs to space research and engineering project management teams | 55,000 | 48,000 | 45,821 |
| 896 01-167 | Contributions to the European Space Organization (ESO) in Paris | 891,600 | | |
| Tgr.01 | Funding of orbital structures and space transport systems and selected exploitation | (178,000) | (149,500) | (130,836) |
| 683 13-167 | Research and development projects | 126,000 | 94,500 | 91,346 |
| 892 13-167 | Investments and investment subsidies | 52,000 | 55,000 | 39,490 |
| Tgr.02 | Funding of the planning, development, construction, and experimental operation of applications satellites and payloads | (40,000) | (45,000) | (48,196) |
| 683 15-167 | Research and development projects | 31,000 | 34,000 | 22,465 |
| 892 15-167 | Investment subsidies | 9,000 | 11,000 | 25,731 |
| Tgr.03 | Funding of basic extraterrestrial research | (112,000) | (103,000) | (88,806) |
| 685 01-167 | Research and development projects | 51,000 | 50,000 | 35,114 |
| 893 20-167 | Investment subsidies | 61,000 | 53,000 | 53,692 |
| Tgr.04 | Funding of aeronautical research and hypersonic engineering | (104,500) | (103,700) | (78,024) |
| 685 02-172 | Funding of individual projects | 53,000 | 46,700 | 43,158 |
| 893 02-172 | Investment subsidies | 51,500 | 57,000 | 34,866 |
| Tgr.05 | German Aerospace Research Facility (DLR) in Cologne | (300,926) | (290,263) | (258,581) |
| 685 55-167 | Operating expenses | 221,576 | 215,363 | 206,183 |
| 893 55-167 | Investments | 79,350 | 74,900 | 52,398 |

## 3007 Marine Research and Engineering, Polar Research

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| Tgr.01 | Institute of Oceanography at Kiel University | (11,490) | (11,023) | (12,775) |
| 652 50-177 | Operating expenses | 10,583 | 10,317 | 9,975 |
| 882 50-167 | Investments | 907 | 706 | 2,800 |
| Tgr.02 | Funding for oceanography and marine engineering | (113,300) | (103,500) | (83,135) |
| 683 21-177 | Marine engineering research and development projects | 34,500 | 25,000 | 40,712 |
| 685 26-173 | Marine research and development projects | 55,500 | 62,000 | 29,206 |
| 892 26-177 | Investment subsidies for marine research | 23,300 | 8,500 | 5,595 |
| Tgr.03 | Funding for polar research | (8,000) | (6,500) | (833) |
| 685 22-177 | Individual projects | 8,000 | 6,500 | 833 |
| 893 22-177 | Investment subsidies | | | |
| Tgr.04 | Alfred Wegener Institute of Polar Research and Oceanography Foundation (AWI) in Bremerhaven | (75,460) | (64,446) | (60,213) |
| 685 50-177 | Operating expenses | 55,445 | 51,196 | 47,903 |
| 893 50-177 | Investments | 20,015 | 13,250 | 12,310 |
| 892 21-177 | Investment subsidies for Oceanography | | 8,000 | 7,622 |

## 3008 Technological Funding Programs

| Title/Function | Allocation | 1990 Budget, in DM1,000 | 1989 Budget, in DM1,000 | 1988 Expenditure, in DM1,000 |
|---|---|---|---|---|
| 683 22-169 | Materials research and metallurgy | 128,600 | 133,000 | 124,494 |
| 683 27-169 | Research and development in biotechnology | 174,750 | 174,000 | 176,332 |
| 686 05-179 | Contributions to the European Conference on Molecular Biology and the European Molecular Biology Laboratory (EMBC and EMBL) in Heidelberg | 15,027 | 14,277 | 13,418 |
| Tgr.01 | Funding of research and development in selected areas of physical and chemical technologies including laser technology | (156,700) | (129,500) | (83,667) |
| 683 20-169 | Funding of research and development in selected areas of physical and chemical technologies | 101,000 | 77,500 | 44,651 |
| 683 21-169 | Funding of research and development in selected areas of laser technology | 55,700 | 52,000 | 39,016 |
| Tgr.02 | Funding of research and development on surface transport and traffic | (174,000) | (182,000) | (214,144) |
| 683 23-172 | Research and development projects | 58,000 | 65,000 | 62,838 |
| 892 23-172 | Investment subsidies | 116,000 | 117,000 | 151,306 |
| Tgr.03 | Biotechnology Research Association (GBF) in Braunschweig-Stoeckheim | (54,099) | (49,929) | (62,327) |
| 685 64-175 | Operating expenses | 35,599 | 33,729 | 30,692 |
| 893 64-175 | Investments | 18,500 | 16,200 | 31,635 |

**Authorized Commitments for Individual Budget 30**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 30 02 | | | | | | | | |
| 526 02—Assessment of the consequences of technology | 8,500 | a) 2,659 | 1,918 | 741 | | | | |
| | | b) 6,200 | 3,200 | 2,000 | 1,000 | | | |
| | | c) 8,800 | | 4,300 | 3,000 | 1,500 | | |
| 531 02—Financial contributions to fairs and exhibitions | 2,425 | a) | | | | | | |
| | | b) 2,500 | 1,000 | 1,500 | | | | |
| | | c) 2,500 | | 1,000 | 1,500 | | | |
| 681 05—Grants for exchange of scientists | 17,000 | a)1,000 | 1,000 | | | | | |
| | | b) 15,000 | 7,000 | 5,000 | 3,000 | | | |
| | | c) 9,500 | | 5,000 | 3,000 | 1,500 | | |
| 683 01—Contract research for industrial companies | 39,000 | a) 59,000 | 35,000 | 16,000 | 8,000 | | | |
| | | b) 36,000 | 5,000 | 14,000 | 17,000 | | | |
| | | c) 12,000 | | | | 12,000 | | |
| 683 03—Research cooperation between science and industry | 21,000 | a) 12,773 | 9,737 | 3,036 | | | | |
| | | b) 15,000 | 6,000 | 5,000 | 4,000 | | | |
| | | c) 18,000 | | 7,000 | 6,000 | 5,000 | | |
| 683 29—Innovation risk in technology-oriented product development and establishment of firms | 46,500 | a) 29,894 | 24,894 | 3,000 | 2,000 | | | |
| | | b) 97,000 | 23,500 | 20,500 | 3,500 | | 49,500 | |
| | | c) 74,000 | | 6,000 | 10,000 | 10,000 | 3,500 | 44,500 |
| 685 02—Grants for selected researchers | 11,250 | a) 12,950 | 6,750 | 4,200 | 2,000 | | | |
| | | b) 9,500 | 1,900 | 2,900 | 2,500 | 2,200 | | |
| | | c) 8,300 | | 1,875 | 1,875 | 2,300 | 2,250 | |
| 685 04—Technology transfer | | a) 4,424 | 2,424 | 1,000 | 1,000 | | | |
| | | b) 1,126 | 376 | 500 | 250 | | | |
| | | c) | | | | | | |
| 685 05—Support of peace and conflict research | 3,300 | a) 2,000 | 1,600 | 400 | | | | |
| | | b) 3,000 | 1,200 | 1,000 | 800 | | | |
| | | c) 3,600 | | 1,400 | 1,200 | 1,000 | | |
| 685 06—Social science research | 5,600 | a) 1,551 | 1,250 | 301 | | | | |
| | | b) 5,800 | 2,800 | 1,800 | 1,200 | | | |
| | | c) 6,200 | | 2,400 | 2,000 | 1,800 | | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| 685 58—Institutional funding of humanities organizations | 21,840 | a) | | | | | | |
| | | b) 70 | 70 | | | | | |
| | | c) 75 | | 75 | | | | |
| 685 61—Humanities projects | 5,500 | a) 447 | 447 | | | | | |
| | | b) 8,427 | 2,727 | 2,700 | 2,000 | 1,000 | | |
| | | c) 5,200 | | 1,700 | 1,300 | 1,200 | 1,000 | |
| 685 62—Scientific Film Institute | 4,905 | a) | | | | | | |
| | | b) 63 | 63 | | | | | |
| | | c) | | | | | | |
| 686 30—Scientific and technological cooperation with other countries and between the two Germanies | 18,300 | a) | | | | | | |
| | | b) 2,000 | 2,000 | | | | | |
| | | c) 8,900 | | 3,700 | 2,000 | 3,200 | | |
| 893 52—MPG investments | 65,490 | a) 25,000 | 17,000 | 8,000 | | | | |
| | | b) 27,000 | 10,000 | 9,000 | 8,000 | | | |
| | | c) 27,000 | | 10,000 | 9,000 | 8,000 | | |
| 893 56—FhG investments | 73,955 | a) 62,000 | 40,000 | 22,000 | | | | |
| | | b) 53,000 | 13,000 | 18,000 | 22,000 | | | |
| | | c) 53,000 | | 13,000 | 18,000 | 22,000 | | |
| | | | | | | | | |
| 30 03 | | | | | | | | |
| 652 50—Kiepenhauer Institute | 2,273 | a) | | | | | | |
| | | b) 250 | 250 | | | | | |
| | | c) 250 | | 250 | | | | |
| 683 19—Improvement of working conditions | 97,500 | a) 62,636 | 44,666 | 15,961 | 2,009 | | | |
| | | b) 92,000 | 33,400 | 28,600 | 17,000 | 13,000 | | |
| | | c) 90,000 | | 31,800 | 28,200 | 17,000 | 13,000 | |
| 683 21—Geosciences and mining engineering | 61,000 | a) 72,000 | 36,000 | 24,000 | 12,000 | | | |
| | | b) 48,000 | 12,000 | 12,000 | 12,000 | 12,000 | | |
| | | c) 46,000 | | 10,000 | 12,000 | 12,000 | 12,000 | |
| 685 23—Health service, medical research | 160,000 | a) 133,009 | 70,571 | 44,576 | 17,862 | | | |
| | | b) 150,000 | 50,000 | 50,000 | 25,000 | 15,000 | 10,000 | |
| | | c) 160,000 | | 50,000 | 50,000 | 30,000 | 20,000 | 10,000 |
| 685 51—ISAS | 5,631 | a) | | | | | | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| | | b) 165 | 165 | | | | | |
| | | c) 150 | | 150 | | | | |
| 683 17—Construction research, projects | 36,000 | a) 29,639 | 22,607 | 7,032 | | | | |
| | | b) 34,700 | 7,700 | 12,000 | 11,000 | 4,000 | | |
| | | c) 36,000 | | 10,000 | 12,000 | 10,000 | 4,000 | |
| 892 17—Construction research, investment | 4,000 | a) 3,565 | 2,337 | 778 | 450 | | | |
| | | b) 4,040 | 860 | 980 | 1,200 | 1,000 | | |
| | | c) 4,250 | | 1,400 | 1,350 | 1,000 | 500 | |
| 683 24—Ecological research, environmental technology projects | 195,600 | a) 89,906 | 64,692 | 22,169 | 3,045 | | | |
| | | b) 255,000 | 72,000 | 82,500 | 53,500 | 47,000 | | |
| | | c) 204,000 | | 46,000 | 75,000 | 43,000 | 40,000 | |
| 892 24—Ecological research, environmental technology investments | 61,300 | a) 45,586 | 30,607 | 12,463 | 2,516 | | | |
| | | b) 54,000 | 14,000 | 20,000 | 10,000 | 10,000 | | |
| | | c) 60,000 | | 14,000 | 22,000 | 12,000 | 12,000 | |
| 685 01—Basic natural science research, research projects | 81,000 | a) 131,355 | 60,446 | 59,509 | 11,400 | | | |
| | | b) 24,600 | 3,900 | 700 | 20,000 | | | |
| | | c) 5,500 | | 3,000 | 1,500 | 1,000 | | |
| 893 01—Natural science investment, basic research | 45,000 | a) 93,975 | 48,706 | 38,241 | 7,028 | | | |
| | | b) 267,800 | | | | | | 267,800 |
| | | c) 7,000 | | 4,000 | 2,000 | 1,000 | | |
| 893 55—DKFZ - investment | 32,000 | a) 6,750 | 6,750 | | | | | |
| | | b) 13,950 | 9,450 | 4,500 | | | | |
| | | c) 15,300 | | 12,150 | 3,150 | | | |
| 893 60—DESY - investment | 67,150 | a) 45,000 | 27,000 | 18,000 | | | | |
| | | b) 49,900 | 14,400 | 13,800 | 21,700 | | | |
| | | c) 47,000 | | 14,700 | 10,700 | 21,600 | | |
| 893 61—GSI - investment | 35,699 | a) 20,000 | 20,00 | | | | | |
| | | b) 14,000 | 9,000 | 5,000 | | | | |
| | | c) 13,900 | | 9,000 | 4,900 | | | |
| 893 62—HMI - investment | 25,000 | a) 450 | 450 | | | | | |
| | | b) 5,400 | 4,500 | 900 | | | | |
| | | c) 5,400 | | 4,500 | 900 | | | |
| 893 63—GSF - investment | 30,000 | a) 3,000 | 3,000 | | | | | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| | | b) 5,400 | 4,050 | 1,350 | | | | |
| | | c) 7,217 | | 4,317 | 1,450 | 1,450 | | |
| 686 51—European Synchrotron Radiation Facility | 28,000 | a) | | | | | | |
| | | b) | | | | | | |
| | | c) 46,000 | | 20,000 | 16,000 | 10,000 | | |
| 30 04 | | | | | | | | |
| 683 23—Manufacturing engineering | 107,000 | a) 190,238 | 93,113 | 67,126 | 29,999 | | | |
| | | b) 140,000 | 40,000 | 42,000 | 50,000 | 8,000 | | |
| | | c) 84,000 | | 3,000 | 20,000 | 44,000 | 17,000 | |
| 683 41—Technical communications | 93,000 | a) 78,000 | 48,000 | 20,000 | 10,000 | | | |
| | | b) 97,600 | 43,000 | 27,000 | 27,600 | | | |
| | | c) 46,000 | | 21,000 | 13,000 | 12,000 | | |
| 683 42—Information processing | 93,000 | a) 11,808 | 11,808 | | | | | |
| | | b) 106,000 | 40,000 | 21,000 | 45,000 | | | |
| | | c) 109,000 | | 50,000 | 19,000 | 40,000 | | |
| 683 40—Electronics - projects | 151,000 | a) 105,888 | 66,610 | 33,718 | 5,560 | | | |
| | | b) 90,000 | 15,000 | 25,000 | 40,000 | 10,000 | | |
| | | c) 120,000 | | 40,000 | 40,000 | 30,000 | 10,000 | |
| 683 46—Microperipherals | 94,000 | a) 90,939 | 50,987 | 30,636 | 9,316 | | | |
| | | b) 40,000 | 5,000 | 9,000 | 12,000 | 14,000 | | |
| | | c) 88,000 | | 32,000 | 25,000 | 21,000 | 10,000 | |
| 892 40—Electronics - investment | 36,000 | a) 7,848 | 6,663 | 1,185 | | | | |
| | | b) 180,000 | 40,000 | 50,000 | 50,000 | 40,000 | | |
| | | c) 40,000 | | 10,000 | 10,000 | 10,000 | 10,000 | |
| 893 50—GMD - investment | 25,830 | a) | | | | | | |
| | | b) 17,300 | 11,000 | 6,300 | | | | |
| | | c) 6,480 | | 6,480 | | | | |
| 893 5—HHI - investment | 3,500 | a) | | | | | | |
| | | b) 1,175 | | | | | | 1,175 |
| | | c) 1,250 | | 1,250 | | | | |
| 685 60—Specialized information, individual projects | 36,000 | a) 27,980 | 20,151 | 7,829 | | | | |
| | | b) 36,400 | 5,900 | 6,500 | 15,200 | 8,800 | | |
| | | c) 39,400 | | 19,000 | 11,200 | 9,200 | | |
| 893 60—Specialized information, investment | 5,500 | a) | | | | | | |
| | | b) 8,400 | 3,600 | 2,700 | 1,400 | 700 | | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| | | c) 4,500 | | 1,500 | 1,500 | 1,500 | | |
| 893 61—Interregional information centers - investment | 7,047 | a) | | | | | | |
| | | b) 5,154 | 4,524 | 630 | | | | |
| | | c) 1,676 | | 1,676 | | | | |
| 30 05 | | | | | | | | |
| 683 15—Risk participation, nuclear energy | 20,000 | a) | | | | | | |
| | | b)60,000 | | | | | | 60,000 |
| | | c) | | | | | | |
| 683 26—Nuclear fuel procurement | 2,500 | a)335 | 335 | | | | | |
| | | b) 3,140 | 640 | 500 | 2,000 | | | |
| | | c) 1,100 | | 1,100 | | | | |
| 685 07—Reactor safety | 105,000 | a) 82,524 | 52,419 | 29,871 | 234 | | | |
| | | b) 110,700 | 30,100 | 34,600 | 24,000 | 22,000 | | |
| | | c) 109,400 | | 23,600 | 41,800 | 22,000 | 22,000 | |
| 686 05—IAEO | 32,611 | a) | | | | | | |
| | | b) 1,500 | 1,500 | | | | | |
| | | c) 1,500 | | 1,500 | | | | |
| 683 13—Rational energy exploitation - projects | 102,000 | a) 86,439 | 45,008 | 31,990 | 9,441 | | | |
| | | b) 119,000 | 33,000 | 24,000 | 23,000 | 39,000 | | |
| | | c) 116,000 | | 31,000 | 37,000 | 9,000 | 24,000 | 15,000 |
| 683 16—Coal technology - projects | 40,000 | a) 61,824 | 34,418 | 23,841 | 3,565 | | | |
| | | b) 31,200 | 6,000 | 6,200 | 9,000 | 10,000 | | |
| | | c) 34,900 | | 5,000 | 12,000 | 8,900 | 9,000 | |
| 892 13—Rational energy exploitation - investment | 153,000 | a) 146,030 | 73,124 | 43,880 | 29,026 | | | |
| | | b) 111,000 | 35,000 | 27,000 | 23,000 | 26,000 | | |
| | | c) 130,000 | | 40,000 | 30,000 | 30,000 | 30,000 | |
| 892 16—Coal technology - investment | 76,000 | a) 68,438 | 40,352 | 18,055 | 10,031 | | | |
| | | b) 75,000 | 24,000 | 24,000 | 17,000 | 10,000 | | |
| | | c) 60,000 | | 15,000 | 15,000 | 15,000 | 15,000 | |
| 892 18—Coal upgrading plants | 25,000 | a) 46,306 | 24,570 | 11,736 | 10,000 | | | |
| | | b) 23,000 | 6,000 | 6,000 | 5,000 | 6,000 | | |
| | | c) 16,500 | | 4,700 | 1,800 | 5,000 | 5,000 | |
| 683 12—High-temperature reactors | 30,000 | a) 28,263 | 14,105 | 8,325 | 5,833 | | | |
| | | b) 28,500 | 9,000 | 9,500 | 4,500 | 5,500 | | |
| | | c) 26,000 | | 6,000 | 7,500 | 6,500 | 6,000 | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| 683 19—Development of a heat reactor | 3,000 | a) | | | | | | |
| | | b) | | | | | | |
| | | c) 31,700 | | 6,700 | 7,500 | 7,500 | 5,000 | 5,000 |
| 892 11—Fast-breeder reactor | 79,000 | a) 7,937 | 7,937 | | | | | |
| | | b) 159,700 | 60,700 | 59,400 | 39,600 | | | |
| | | c) 43,000 | | 5,000 | 10,000 | 28,000 | | |
| 683 27—Nuclear waste disposal, research and development | 43,000 | a) 38,175 | 24,410 | 7,265 | 6,500 | | | |
| | | b) 63,000 | 20,000 | 25,000 | 10,000 | 8,000 | | |
| | | c) 34,000 | | 11,000 | 8,500 | 7,500 | 7,000 | |
| 893 27—Nuclear waste disposal | 26,000 | a)34,942 | 16,000 | 15,942 | 3,000 | | | |
| | | b) 44,000 | 12,500 | 12,000 | 12,000 | 7,500 | | |
| | | c) 15,200 | | | 9,500 | 3,300 | 2,400 | |
| 893 50—KfK - investment | 76,000 | a) 27,500 | 20,300 | 7,200 | | | | |
| | | b) 66,600 | 43,200 | 15,300 | 8,100 | | | |
| | | c) 63,900 | | 41,400 | 14,400 | 8,100 | | |
| 893 55—KFA - investment | 83,100 | a) 5,400 | 3,600 | 1,800 | | | | |
| | | b) 26,100 | 18,900 | 4,500 | 2,700 | | | |
| | | c) 24,300 | | 16,200 | 4,500 | 3,600 | | |
| 893 62—IPP - investment | 24,380 | a) 9,306 | 9,306 | | | | | |
| | | b) 38,646 | 18,864 | 19,782 | | | | |
| | | c) 20,798 | | 5,681 | 15,117 | | | |
| 893 65—GKSS - investment | 19,520 | a) | | | | | | |
| | | b) | | | | | | |
| | | c) 10,800 | | 8,730 | 2,070 | | | |
| 30 06 | | | | | | | | |
| 683 05—Space research - strategic studies | 27,000 | a) 7,948 | 5,948 | 2,000 | | | | |
| | | b) 30,500 | 12,500 | 10,000 | 8,000 | | | |
| | | c) 34,500 | | 12,500 | 11,000 | 9,000 | 2,000 | |
| 683 13—Exploitation of orbital systems | 126,000 | a) 45,441 | 33,670 | 10,152 | 1,619 | | | |
| | | b) 132,900 | 47,200 | 51,700 | 22,000 | 12,000 | | |
| | | c) 338,300 | | 39,300 | 52,400 | 26,000 | 13,000 | 207,600 |
| 892 13—Exploitation of orbital systems - investment | 52,000 | a) 11,021 | 7,494 | 3,527 | | | | |
| | | b) 70,700 | 20,700 | 25,000 | 20,000 | 5,000 | | |
| | | c) 59,000 | | 17,000 | 15,000 | 18,000 | 9,000 | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| 683 15—Application satellites, payload - projects | 31,000 | a) 10,436 | 9,080 | 1,356 | | | | |
| | | b) 34,000 | 14,000 | 12,000 | 8,000 | | | |
| | | c) 22,000 | | 10,000 | 7,000 | 5,000 | | |
| 892 15—Application satellites, payloads - investment | 9,000 | a) 22,312 | 10,000 | 10,000 | 2,312 | | | |
| | | b) 8,000 | 2,000 | 2,000 | 2,000 | 2,000 | | |
| | | c) 13,000 | | 2,000 | 5,000 | 4,000 | 2,000 | |
| 685 01—Basic extraterrestrial research - projects | 51,000 | a) 10,120 | 8,637 | 1,140 | 343 | | | |
| | | b) 47,500 | 17,500 | 10,000 | 10,000 | 10,000 | | |
| | | c) 66,300 | | 30,000 | 20,000 | 13,300 | 3,000 | |
| 893 20—Basic extraterrestrial research - investment | 61,000 | a) 74,821 | 31,813 | 29,008 | 14,000 | | | |
| | | b) 45,400 | 14,600 | 8,800 | 12,000 | 10,000 | | |
| | | c) 43,100 | | 11,000 | 12,000 | 16,600 | 3,500 | |
| 685 02—Aeronautical research and engineering - projects | 53,000 | a) 22,828 | 16,894 | 5,934 | | | | |
| | | b) 75,000 | 25,000 | 25,000 | 25,000 | | | |
| | | c) 81,000 | | 21,000 | 25,000 | 35,000 | | |
| 893 02—Aeronautical research and engineering - investment | 51,500 | a) 150,955 | 32,068 | 39,200 | 33,187 | 6,700 | 39,800 | |
| | | b) 35,000 | 15,000 | 15,000 | 5,000 | | | |
| | | c) 14,000 | | 5,000 | 5,000 | 4,000 | | |
| 893 55—DLR - investment | 79,350 | a) 18,100 | 15,300 | 2,800 | | | | |
| | | b) 44,700 | 28,600 | 13,800 | 2,300 | | | |
| | | c) 32,400 | | 24,400 | 7,100 | 900 | | |
| 30 07 | | | | | | | | |
| 683 21—Marine engineering - projects | 34,500 | a) 13,401 | 10,822 | 2,579 | | | | |
| | | b) 23,000 | 7,700 | 8,000 | 7,300 | | | |
| | | c) 36,500 | | 15,500 | 13,000 | 6,000 | 2,000 | |
| 685 26—Oceanography - projects | 55,500 | a) 4,646 | 4,118 | 528 | | | | |
| | | b) 56,000 | 26,000 | 16,000 | 9,000 | 5,000 | | |
| | | c) 49,000 | | 18,000 | 15,000 | 8,000 | 8,000 | |
| 892 21—Marine engineering - investment | 0 | a) 587 | 587 | | | | | |
| | | b) 8,000 | 3,600 | 2,500 | 1,900 | | | |
| | | c) | | | | | | |
| 892 26—Oceanography - investment | 23,300 | a) 12,000 | 12,000 | | | | | |
| | | b) 500 | 500 | | | | | |

**Authorized Commitments for Individual Budget 30 (Continued)**

| Item, heading (heading group), and destination (in brief) | 1990 estimated expenditure, in DM1,000 | a) commitments approved up to 31 December 1988 and mature as of 1990; b) 1989 authorized commitments, in DM1,000; c) 1990 authorized commitments, in DM1,000 | 1990, in DM1,000 | 1991, in DM1,000 | 1992, in DM1,000 | 1993, in DM1,000 | 1994, in DM1,000 | For future budget years, in DM1,000 |
|---|---|---|---|---|---|---|---|---|
| | | c) 11,500 | | 5,000 | 4,000 | 2,500 | | |
| 685 22—Polar research | 8,000 | a) 708 | 535 | 173 | | | | |
| | | b) 11,900 | 3,400 | 4,000 | 2,500 | 2,000 | | |
| | | c) 10,500 | | 3,000 | 3,500 | 2,000 | 2,000 | |
| 893 50—AWI - investment | 20,015 | a) | | | | | | |
| | | b) 2,850 | 2,850 | | | | | |
| | | c) 17,850 | | 7,850 | 10,000 | | | |
| 30 08 | | | | | | | | |
| 683 22—Materials research, metallurgy | 128,600 | a) 139,617 | 74,249 | 47,168 | 18,200 | | | |
| | | b) 154,500 | 38,500 | 41,000 | 43,200 | 31,800 | | |
| | | c) 107,118 | | 23,735 | 26,373 | 27,390 | 29,620 | |
| 683 27—Biotechnology | 174,750 | a) 188,190 | 98,201 | 73,000 | 16,989 | | | |
| | | b) 140,000 | 50,000 | 35,000 | 35,000 | 20,000 | | |
| | | c) 200,000 | | 40,000 | 57,000 | 63,000 | 40,000 | |
| 683 20—Physical and chemical technologies | 101,000 | a) 37,980 | 26,953 | 9,027 | 2,000 | | | |
| | | b) 138,400 | 43,600 | 40,300 | 43,500 | 11,000 | | |
| | | c) 115,000 | | 35,000 | 30,000 | 30,000 | 20,000 | |
| 683 21—Laser technology | 55,700 | a) 28,838 | 11,477 | 12,562 | 4,799 | | | |
| | | b) 84,900 | 31,500 | 25,400 | 23,000 | 5,000 | | |
| | | c) 61,000 | | 16,500 | 16,500 | 23,000 | 5,000 | |
| 683 23—Surface transport and traffic - research and development | 58,000 | a) 50,710 | 22,638 | 16,825 | 11,247 | | | |
| | b)50,000 | 15,000 | 18,000 | 9,000 | 8,000 | | | |
| | | c) 43,000 | | 12,000 | 11,000 | 11,000 | 9,000 | |
| 892 23—Surface transport and traffic - investment | 116,000 | a) 53,050 | 21,693 | 22,604 | 8,753 | | | |
| | | b) 68,000 | 8,000 | 25,000 | 20,000 | 15,000 | | |
| | | c) 87,000 | | 37,000 | 25,000 | 15,000 | 10,000 | |
| 893 64—GBF - investment | 18,500 | a) | | | | | | |
| | | b) 26,100 | 9,900 | 5,400 | 5,400 | 5,400 | | |
| | | c) 19,800 | | 9,000 | 5,400 | 5,400 | | |
| Total of individual budgets | | b) 4,271,856 | 1,281,764 | 1,168,042 | 971,850 | 462,900 | 59,500 | 327,800 |
| | | c) 3,726,314 | | 1,096,019 | 1,032,685 | 876,740 | 438,770 | 282,100 |

# MICROELECTRONICS

## Microelectronics, Computer Technology Displayed at Leipzig Fair

### General Activities

*23020084 East Berlin RADIO FERNSEHEN ELEKTRONIK in German No 6, Jun 89 p 343*

[Article by W.E. Schlegel: "Leipzig Spring Trade Fair 1989: Effects"]

[Text] This year's Leipzig spring trade fair—held during the most beautiful mild spring weather—had "Flexible Automation" as its theme; in keeping with this theme, a somewhat futuristic pyramid-shaped logo was developed: microelectronics is represented in the peak of the pyramid, but isn't it really the foundation for flexible automation? If this impressive-sounding theme is to have any relation to technical reality, modern semiconductor technology is undeniably a prerequisite. In practice, the conditions were once again correct; interesting new products were introduced by the Carl Zeiss Combine, Jena, and the Mikroelektronik Combine, Erfurt.

The technological maturity of the 1-megabit U 61000 DC DRAM is of great importance, primarily for more advanced VLSI integrated circuits and less so for immediate use. Of course, after going into pilot production (at Zeiss) and subsequent transfer to the Mikroelektronik Combine, this type of memory will naturally also be used in electronic equipment and systems such as those of the Robotron Combine in particular. According to Zeiss, less thought has been given to exports even following production startup set to take place yet this year. Together with the microprocessor systems made by the Mikroelektronik Combine, however, this DRAM is an important prerequisite for successful flexible automation, e.g. in machine construction, and thus brings us back to the fair's theme.

Also in keeping with the theme was the introduction of a new, powerful microprocessor made by the VEB Mikroelektronik Combine in Erfurt.

The unfortunate thing about this product, however, was that although it claimed to be "internationally compatible," no indication was given as to which international system its U 80600 was pin- and function-compatible with. Unfortunately, all of the new products developed by the Mikroelektronik Combine lack this kind of reference information which is standard internationally. The interested engineer and potential user must go to the trouble of individually verifying the pin assignments, voltages, etc., in order to determine what is compatible and what is not. This is neither in the manufacturer's interest, since he is certainly not interested in impermissible data interpolation, nor in the interest of the user who would rather (and should) use his time more constructively, nor with respect to R&D plans; the entire national economy therefore requires the results and not largely unnecessary and time-consuming research.

Of extreme national economic importance, in our opinion, is the introduction of the U 86 C 00 CMOS microprocessor system. The availability of this product closes a gap in our range of semiconductor devices; thanks to our present mastery of CMOS technology, this system now paves the way for mobile microprocessor-controlled devices, for the most varied of applications, which are characterized by low power consumption. In this regard, we noticed at the fair that for the first time in many years the VEB Werk fuer Fernsehelektronik [TV Electronics Plant], Berlin, did not exhibit any of its well-known liquid crystal displays nor did it introduce any new ones. This is even more surprising in view of the fact that this VEB is an important international licensing firm for the production, mixing and use of liquid crystal materials. It is precisely here, in conjunction with the 8-bit CMOS microprocessor system, that the technical policies of the Erfurt Combine could have made a real impression, because LCDs are very important for battery-operated devices. Regardless of the type of device, nearly all of them need a low-power display. Instead, information on these displays not shown at the fair, which have been in production for years, appeared this year for the first time in the reference book "Active Electronic Devices," from which they had previously always been missing.

Exhibit hall 15, now nearly a classic site for information technology at the Leipzig trade fair, was largely taken over by the electronics combines of the GDR: Robotron, Nachrichtenelektronik [Communications Electronics], Mikroelektronik, EAW Berlin-Treptow, etc. Many exhibited fewer individual devices and a greater number of entire systems which can be used very effectively within the national economy either directly or with modifications. Arrangement and presentation were professional and first-rate, although certainly not always understandable to the curious layman even though some products had been developed with him in mind. New were discussions held at the booth of the Mikroelektronik Combine where experts from the enterprises within this combine explained their new products. This was certainly no easy task but was definitely a good start.

Less obvious compared to earlier trade fairs, but still present, was a kind of "preview" of future developments. The Institute for Semiconductor Physics exhibited SOI (silicon on insulator) wafers, and in the Soviet pavilion, a system for manufacturing SOS (silicon on sapphire) wafers and the wafers themselves were exhibited. Both procedures are required for the manufacture of more advanced types of integrated circuits. Devices in SMD-compatible housings, as well as many VLSI ICs on the chip carrier, were represented to a much greater extent than before. This change is a very welcome one and of great importance for the viability of new products on the world market.

A trade fair is usually taxing for the participants but always interesting and educational; one can see how others have approached the problems facing them and the solutions they have found. In many cases, it is

possible to draw conclusions concerning work under way in our country, even though others' solutions cannot be transferred to the conditions in the GDR on a one-to-one basis. A tour of the fair was particularly interesting because, in addition to long-time participants, this year a number of exhibitors from Western Europe and overseas were represented at the Leipzig trade fair for the first time. Many important names were new in Leipzig, including AT&T, Seikosha, Tulip Computers, Schneider and Minolta Austria. The latter company exhibited a highly developed copying technique and is in the process of developing a service network for its equipment in the GDR. Its objective is both remarkable and also worthy of imitation: The equipment must be repaired within 24 hours after the manufacturer has been notified that the equipment has malfunctioned. The reason: Even the cheapest equipment is too expensive when it is down. Should this concept pertain exclusively to Minolta equipment?

## Semiconductor Devices

*23020084 East Berlin RADIO FERNSEHEN ELEKTRONIK in German No 6, Jun 89 pp 344-349*

[Article by W.E. Schlegel: "Leipzig Spring Trade Fair 1989: Effects"]

[Text]

### GDR

The **VEB Carl Zeiss Combine, Jena**, has now introduced to the general public its often-mentioned **U 61000 DC 12, a 1-Mbit DRAM** made by its **VEB Forschungszentrum Mikroelektronik [Microelectronics Research Center], Dresden**, and has also published some of its technical specifications. It has a structure of 1 M x 1 bit (1,048,576 bits); further development is possible based on the same chip, e.g. a structure of 256 K x 4 bits. The memory is intended primarily for computation and information processing.

**Table 1. Some Technical Specifications of the 1-Mbit DRAM U 61000 DC, VEB Carl Zeiss Combine, Jena**

| | | U 61000 DC 12, Basic Type |
|---|---|---|
| U 61000 DC 10, Alternate Version | | |
| Operating voltage in V | 4.5 - 5.5 | 4.5 - 5.5 |
| Operating current in mA | </= 50 | </= 60 |
| Closed-circuit current in mA | | |
| CMOS level | </= 1 | </=1 |
| TTL level | </= 2 | </= 2 |
| Operating temperature in °C | 0 - 70 | 0 - 70 |
| /RAS access time in ns | 120 | 100 |
| /CAS access time in ns | 45 | 35 |
| FPM access time in ns[1] | 60 | 50 |
| Cycle time in ns | 220 | 190 |
| FPM cycle time in ns | 70 | 55 |

[1]FPM = fast page mode

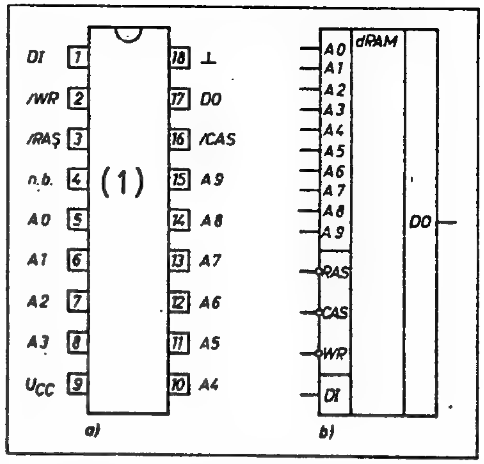


**Figure 1. 1-Mbit DRAM U 61000 DC 12, VEB Carl Zeiss Combine, Jena. a) Pin assignments; b) Suggested symbol**

Key:—1. not used

It is made using n-channel CMOS technology with a structural resolution of 1 μm. The bits are stored in single-transistor memory cells. This feature as well as four conducting layers (two of polysilicon, one of molybdenum silicide and one of aluminum) permit a high packing density, thus the chip is accommodated within an 18-pin DIP. The technology used in the memory provides protection against soft errors, the latch-up effect and electrostatic charges. The inputs and outputs are CMOS- and TTL-compatible; the output stages are designed as tristate outputs. The chip requires 512 8 ms-long refresh cycles.

The **IS U 1159 DC**, which is intended for use in frequency measurement systems and in radio and television digital tuning and display systems, also uses CMOS technology. It contains a programmable

HF splitter with preamplifier; the following ratios can be programmed: 10:1, 32:1, 33:1, 64:1, 65:1, 100:1, 101:1, 110:1 and 111:1. The input frequency is between 0.6 and 125 MHz; the circuit has complementary outputs. Separate operating voltages and chassis grounds are required for the analog and digital sections: $U_{CC}$ = 4.75 to 5.25 V referred to the appropriate chassis ground; input voltages of the control inputs are $U_{IL}$ = -0.3 to 1 V and $U_{IH}$ = ($U_{CCD}$ -1 V) to ($U_{CCD}$ + 0.3 V); the input voltage of the signal inputs is 100 to 1000 mV (f = 5 to 125 MHz); the output voltages $U_{OL}$ </= 2.4 V and $U_{OH}$ >= 8.5 V; power consumption $I_{CC}$ </= 40 mA; permanent output current $I_O$ </= 20 mA; power dissipation $P_V$ </= 0.25 W; operating temperature range $\theta_a$ = 0 to 70°C.

The **U 1600 Standard Cell System** consists of the standard cell catalog with logic, driver, flip-flop, interface and system-internal cells; fixed block generators for RAMs, ROMs and PLAs; the CAD system for layout generation and the user manual. It is to be viewed as a further development of the U 1500 and U 1520 standard cell systems. Up to $10^5$ transistors can be integrated on one chip depending on the size of the fixed blocks used,

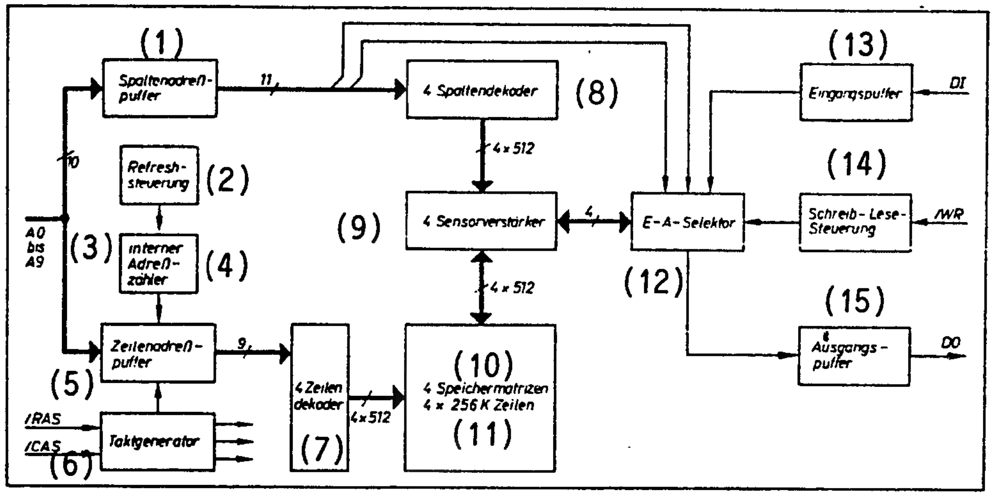


**Figure 2. Block Diagram of 1-Mbit DRAM U 61000 DC 12, Carl Zeiss Combine, Jena**

Key:
1. Column address buffer
2. Refresh control
3. to
4. Internal address counter
5. Line address buffer
6. Clock generator
7. 4 Line decoders
8. 4 Column decoders
9. 4 Sensor amplifiers
10. 4 Storage matrices
11. 4 x 256 K lines
12. I/O selector
13. Input buffer
14. Write/read control
15. Output buffer

and different packing densities are used: 1000 transistors/mm$^2$ for logic, 20,000 transistors/mm$^2$ for ROMs and approximately 12,000 transistors/mm$^2$ for RAMs. A maximum of 108 user-specific pins are available depending on the housing used. The semiconductor devices are made using 1.5 µm CMOS technology to achieve the following main parameters: $U_{CC}$ = 4.75 to 5.25 V, $U_{IL}$ = -0.3 to 0.8 V, $U_{IH}$ = 2.4 V to ($U_{CC}$ + 0.3 V), $U_{OL}$ </= 0.4 V with $I_O$ = 5 mA, $U_{OH}$ >= 2.4 V with $I_O$ = -1 mA, closed-circuit current < 400 µA, clock frequency > 25 MHz, gate delay < 1.6 ns. We will come back to this semi-custom system in the necessary detail in our ASICs series, and will also cover the new **U 5300 Gate Array System.** This system comprises three masters, the macro cell catalog, the design system and an organizational project. The U 5301 master contains approximately 40,000 transistors—3840 gate equivalent circuits for combiner circuits and 360 freely configurable master/slave flip-flops. The U 5302 master incorporates approximately 70,000 transistors—2640 gate equivalent circuits for combiner circuits, 200 master/slave flip-flops and 4 Kbits of SRAM.

The **VEB Keramische Werke [Ceramics Plants] Combine in Hermsdorf** has developed a **4-Mbit DRAM**, but as a hybrid. It contains sixteen U 61256 256-Kbit DRAM chips located on an $Al_2O^3$ PC board in DIPs. The inputs and outputs are TTL-compatible and the access time is 100 ns. $U_{CC4}$ = 4.5 to 5.5 V, $I_{CC}$ </= 500 mA, closed-circuit current is 50 mA, soft error rate is 2000, weight is 10 g and the probability of failure is 1 x $10^{-6}$/h.

The **VEB Halbleiterwerk [Semiconductor Plant], Frankfurt (Oder)**, has introduced three new highly integrated circuits for a new generation of color television sets. These ICs are intended to reduce the manufacturer's use of external components and minimize adjustment procedures. At the same time, usability is improved by automatic cut-off device system and by the ability to connect other communications systems and process signals used by all commercial color television standards, as well as by increased reliability.

The **A 4555 DC Multiple-Standard Decoder** processes PAL, SECAM and NTSC signals (3.58 MHz and 4.43 MHz), and contains the chromaticity section (servo-controlled color signal amplifier, control voltage generator, PAL color burst blanking circuitry, line driver outputs for a 64-µs delay line, limiters for delayed and non-delayed SECAM signals, SECAM back-to-back switch, the demodulator section and the identification section. The color difference output signals are negative. The IC allows the user to select from H, V, or combined H and V identification, as well as to adjust the chrominance (NTSC). The **A 4565 DC IC** crispens the color difference signals and compensates for the time delay of the luminance signal. The rise times of the chrominance signals of the multiple-standard decoder are shortened from 550-800 ns to 100 ns, which improves picture sharpness. The luminance signal (Y) can be delayed for between 720 and 990 ns (depending on system type), which eliminates the customary external delay lines. This IC incorporates the integrated gyrator delay circuit which can be set to respond in 45-ns increments, the color difference channels R-Y and B-Y with memory stages and the output for velocity modulation of the horizontal sweep.

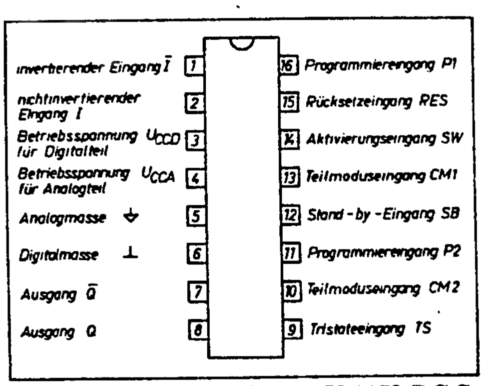


**Figure 3. Pin Assignments for the U 1159 DC Splitter IC; VEB Carl Zeiss Combine, Jena**

Key:—1. Inverting input—2. Non-inverting input—3. Operating voltage for digital section—4. Operating voltage for analog section—5. Analog ground—6. Digital ground—7. Output—8. Output—9. Tristate input—10. Section mode input—11. Programming input—12. Standby input—13. Partial mode input—14. Activating input—15. Reset input—16. Programming input

The **video combination A 4580 DC** performs automatic blocking compensation so that the aging of picture tubes now no longer affects picture quality. It has two independent RGB inputs which allow the input of signals from two external RGB video sources (videotex decoders, satellite decoders, computers, video games and video CD players). Because changeover is fast, video frames can also be input. While all adjustments can be made at RGB 1 (SCART jack), only the brilliance can be adjusted at RGB 2. The bandwidth of all video channels is 10 MHz. This IC is used to advantage not only in television sets, but also in color monitors. All three integrated circuits provide much more performance with simplified wiring. Costs can be reduced by omitting the A 4565 DC.

The high-quality **precision BiFET operational amplifier B 411 DD** is pin-compatible with the popular operational amplifiers B 081 D and B 061 D. Its input stage incorporates SFETs; the further processing of signals is accomplished by bipolar transistors. This design achieves a high input impedance, low self-capacitance, low offset adjust, and a high degree of thermal stability, and differential-mode and common-mode rejection. Of all of these excellent characteristics, the manufacturer unfortunately documents only the common-mode rejection: >= 86 dB. Additional technical specifications include $U_{CC+} = -U_{CC-} = 5$ to 18 V, push-pull input voltage $U_{IC} = -(U_{CC-} + 4\ V)$ to $(U_{CC+} - 2\ V)$. Output current $I_O$ </= 20 mA, current consumption </= 2.8 mA, input offset current </= 50 pA, open voltage amplification >= 100 dB, operating voltage suppression >= 86 dB, transition frequency </= 2 MHz. The IC is packaged in an 8-pin DIP.

The integrated **B 466 GA Hall IC** is used primarily as a position sensor in electronic ignition systems for gasoline engines. Its operating voltage lies between 4.5 and 12 V, and it can operate in the temperature range of -25 to +130°C, thus it is well suited to the rough operating conditions found in automotive applications. Technical specifications include a current consumption of </= 14 mA, switch-on magnetic flux density $B_E$ </= 30 mT, switch-off magnetic flux density $B_A$ >= -30 mT, changeover point at 0 mT, hysteresis $\Delta B = 4$ to 20 mT, output

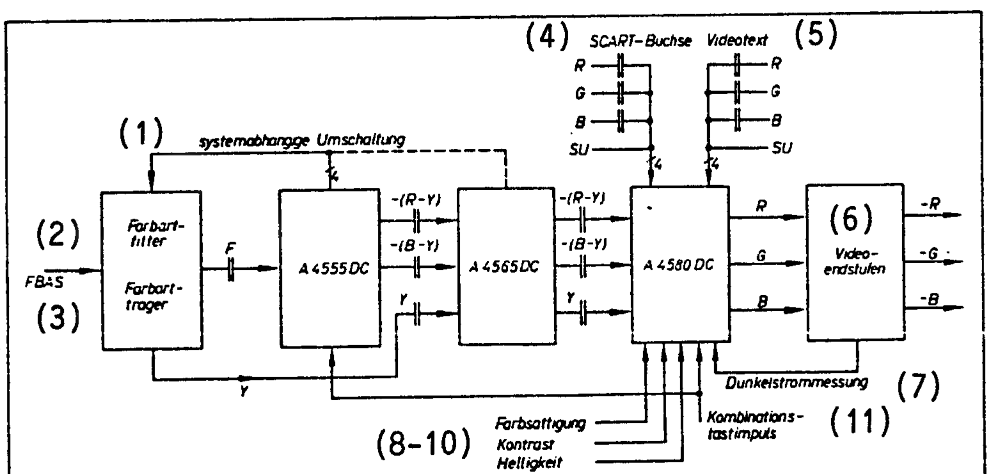


**Figure 4. Block Diagram Showing the Interconnection of ICs A 4555 DC, A 4565 DC and A 4580 DC Manufactured by VEB Halbleiterwerk, Frankfurt [Oder]**

Key:
1. System-dependent switchover
2. Chrominance filter
3. Chrominance carrier
4. SCART jack
5. Videotext
6. Video output stages
7. Electrode dark current measurement
8. Color saturation
9. Contrast
10. Brilliance
11. Combined sampling pulse

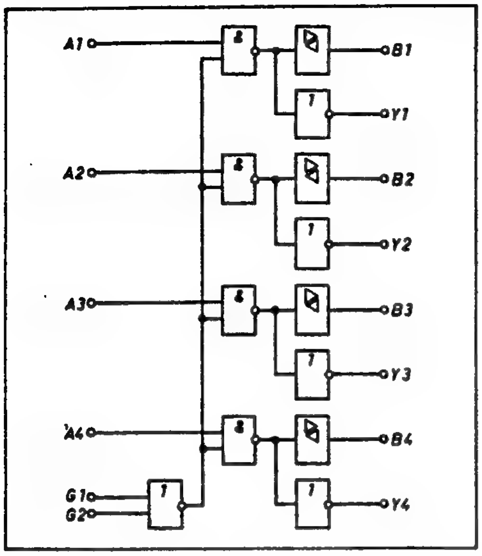


**Figure 5. Block Diagram of the DL 8641 DC Manufactured by VEB Halbleiterwerk, Frankfurt (Oder)**

current </= 10 μA. The **B 2600 DG driver IC** is designed for use in the secondary circuits of switched-mode power supplies. It contains the closed-loop control assembly which drives the pulse-duration modulator, and a monitoring circuit whose function is to protect the electronics, which are powered by the switched-mode power supply, in the event of a malfunction. This protective circuit comprises undervoltage protection, undervoltage signaling and storage, overvoltage protection with and without delay time, overvoltage signaling, protective triggering of an external thyristor, power failure detection. The IC is subdivided into a closed-loop control section and the above mentioned monitoring section; both are completely mutually independent, and also have separate grounds and operating voltages ($U_{CC1}$ = 10 to 35 V for the control section, and $U_{CC2}$ = 4.5 to 35 V for the monitoring section).

The **B 2960 VG DC-DC reverse automatic gain control** works in conjunction with a storage/memory limiter, a charging capacitor and a freewheeling diode as a switching controller; an output transistor for output currents up to 4 A is already integrated into the chip. Because the output voltage can be as high as 40 V, the maximum output power is 160 W. The efficiency of the chip is 75 to 90 percent, and the power dissipation in many applications remains under 10 W. With this IC, power supply circuits with low heat generation and stable output voltage can be designed with very small footprints for applications such as in computer peripherals. For this application, in addition to customary protective circuits (monitoring of overvoltage and chip temperature, externally adjustable current limiting), the IC implements special functions: reset in the event of power fading, standby operation via an inhibit function, synchronization of switching frequency, and soft starts.

The IC is housed in a so-called 15-pin multiwatt package. Technical specifications include an input voltage of 9 to 46 V, output voltage </= 40 V, I/O differential voltage </= 50 V, power dissipation </= 20 W, $\theta_a$ = -25 to 150°C.

The **low-power Schottky TTL Series DL 000** has been expanded by the addition of three new chips:

**DL 005 DC** six inverters with open-collector outputs **DL 016 DC** six inverting buffers and drivers with open-collector outputs and an output voltage of 15 V.

**DL 026 D** four NAND gates, each with two inputs, open-collector outputs and an output voltage of 15 V.

The **DL 8640 DC bus receiver IC** contains four bus receivers, each with two NORed inputs; the switching threshold is 1.5 V. The push-pull output stages are rated at 16 mA at $U_{OL}$ = 0.4 V. The IC is designed for use in bus-based data transmission systems whose 120 Ω data bus has an impedance of 180 Ω with respect to $U_{CC}$ and 390 Ω with respect to chassis ground. Type **DL 8641 DC** is likewise designed for this type of bus system which contains four integrated bus drivers and receivers. The chip has open-collector bus driver outputs rated at 50 mA at $U_{OL}$ = 0.7 V. The receiver outputs have push-pull stages rated at 16 mA. The operation of the IC is controlled via the two control inputs G1 and G2.

The **DL 75113 DC power transmitter** IC contains two power transmitters which generate difference signals in accordance with CCITT Recommendation V.11 for symmetrical interfaces when external push-pull stages are present as output stages. Open-collector operation is also possible. Three control inputs can be used either to activate the output stages of the two transmitters or to switch them to high impedance. The maximum possible transmission rate is 10 Mbits/second, and the maximum distance is 1200 meters.

New products were also introduced in the Schottky TTL family. The **DS 140 DC** contains two NAND gates, each with four inputs, and has an output impedance of 50 Ω; it operates as a line driver. Current consumption is $I_{CC}$ </= 44 mA; propagation delay ($t_{PHL}$ and $t_{PLH}$ are given as </= 9.5 ns.

The **DS 157 DC multiplexer** selects a 4-bit data word from two sources and outputs it in a non-inverted state. The maximum propagation delay lies between 10 and 18 ns, depending on which input is driving the output.

The **4-bit DS 2510 DC shift register** shifts four data bits by a maximum of three places. It has seven data inputs and four tristate output stages, one /OE tristate control input and two additional control inputs which are used to set the shift range. Current consumption $I_{CC}$ </= 95 mA; propagation delay lies between 12 and 20 ns, depending on the mode of operation.

The **DS 2610 DC IC** has four fast inverting bus driver stages with open-collector outputs, and four inverting bus receiver stages with a switching threshold of 2.0 V.

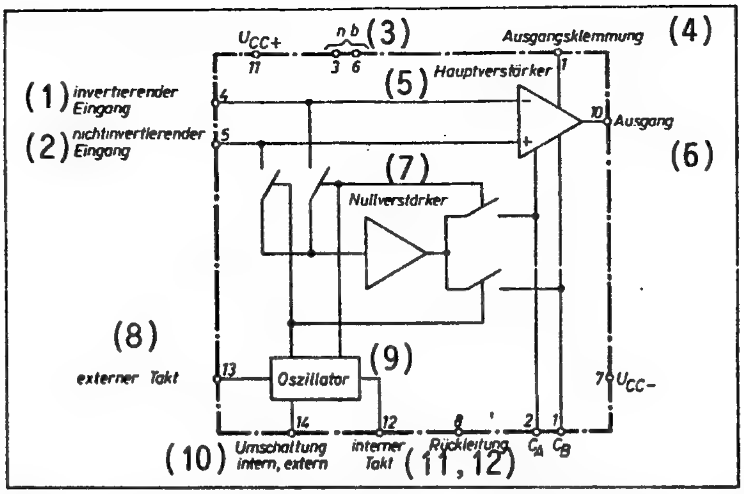


**Figure 6. Circuit Diagram of the U 7650 DD CMOS Operational Amplifier, Manufactured by VEB Halbleiterwerk, Frankfurt (Oder)**

Key:
1. Inverting input
2. Non-inverting input
3. Not used
4. Output clamping
5. Main amplifier
6. Output
7. Null detector
8. External clock
9. Oscillator
10. Internal/external changeover
11. Internal clock
12. Return line

With $U_{OL}$ = 0.8 V, each driver is capable of handling 100 mA. The bus driver outputs can be switched to high impedance via a control input, so that different semiconductor devices can be served via one bus. Propagation delay lies between 15 and 21 ns. The **U 739 DC** is an integrating, data bus-compatible **12-bit CMOS A/D Converter**. Data are converted byte by byte and are output in BCD format. Data transmission is controlled by a microprocessor. This semiconductor device uses the dual slope integration method with cyclic offset balancing and zero-level integration. The conclusion of the conversion process and the updating of the latch contents are indicated at a special output which can be used to handle an interrupt request. The device converts within the range of -2089 and 2089, and one conversion requires 16,000 clock pulses. Technical specifications include $U_{CC+}$ = $-U_{CC-}$ = 4.75 to 5.25 V, linearity error of -1 to 1 LSB, data bus output voltages $U_{DOH}$ = 4 V to $U_{CC+}$, $U_{DOL}$ = 0 to 0.5 V, rollover error -1 to 1 LSB, push-pull voltage 2.6 to 3.4 V, clock frequency 50 kHz +/-5 Hz. The IC is packaged in a 28-pin DIP based on inch dimensions. Two external resistors and one capacitor allow the **U 4541 DG programmable CMOS timer** to generate clock frequencies of from 1 Hz to at least 100 kHz. Connected downstream of the oscillator is a counter with a programmable modulus of $2^8$, $2^{10}$, $2^{13}$ or $2^{16}$. Application of operating voltage resets the IC, and an output control selects the voltage level assumed by the output when the chip is reset. If the chip is operated as a monostable multivibrator, this characteristic can be used to implement switch-off delays of from 1.5 ms to 9 h; this range can be extended by cascading several U 4541 DGs. Operating voltage $U_{DD}$ = 3 to 15 V; the automatic reset function is implemented with $U_{DD}$ >= 8.5 V. The input voltages are: $U_{IH}$ = 3.5 to 5 V (with $U_{DD}$ = 5 V), 7.0 to 10 V (at 10 V), 11.0 to 15 V (at 15 V), $U_{IL}$ </= 1.5 V (with $U_{DD}$ = 5 V), </= 3.0 V (at 10 V) and </= 4.0 V (at 15 V).

The chopper-stabilized **U 7650 DD CMOS operational amplifier** achieves its minimum offset voltage of 5 µV (typ.) by comparing the voltages at the inverting and non-inverting inputs via a null detector. The compensation voltage is stored in two external capacitors $C_A$ and $C_B$; internally, the IC is compensated for a gain of 1. The main amplifier gain is reduced before the maximum output level is reached. Technical specifications include $U_{CC+}$ = $-U_{CC-}$ = 2.5 to 8 V, input offset voltage </= 20 µV, output voltage range >= +/-4.7 V, open voltage gain >= 110 dB, push-pull input voltage -5 to 2.5 V, common-mode rejection >= 110 dB, operating voltage suppression >= 110 dB. Input base current </= 100 pA (2 pA typ.), input offset current </= 20 pA (1 pA typ.), internal clock frequency 200 Hz. The IC is packaged in a 14-pin DIP.

The **Schottky diodes** SY 525 and SY 526 made by **VEB Mikroelektronik "Robert Harnau," Grossraeschen** had already been introduced in RADIO FERNSEHEN ELEKTRONIK No 3 (1986), page 195; the manufacturer introduced for the first time at this trade fair diode type **SY 526,** which was developed together with the **Institute for Electronic Physics** of the Academy of Sciences of the GDR. There are four sub-types with different reverse voltages: SY 526/0.3 ($U_{RRM}$ = 30 V), SY 526/0.35 (35 V), SY 526/0.4 (40 V) and SY 526/0.45 (45 V). The voltage rise time is 1000 V/µs, RMS forward current $I_{F(RMS)}$ = 39 A, average forward current $I_{F(AV)}$ = 25 A; remaining technical specifications are as cited in the above-mentioned journal.

The **epitaxial power rectifier diode SY 625** is also available in four versions, depending on the reverse voltage $U_{RRM}$:

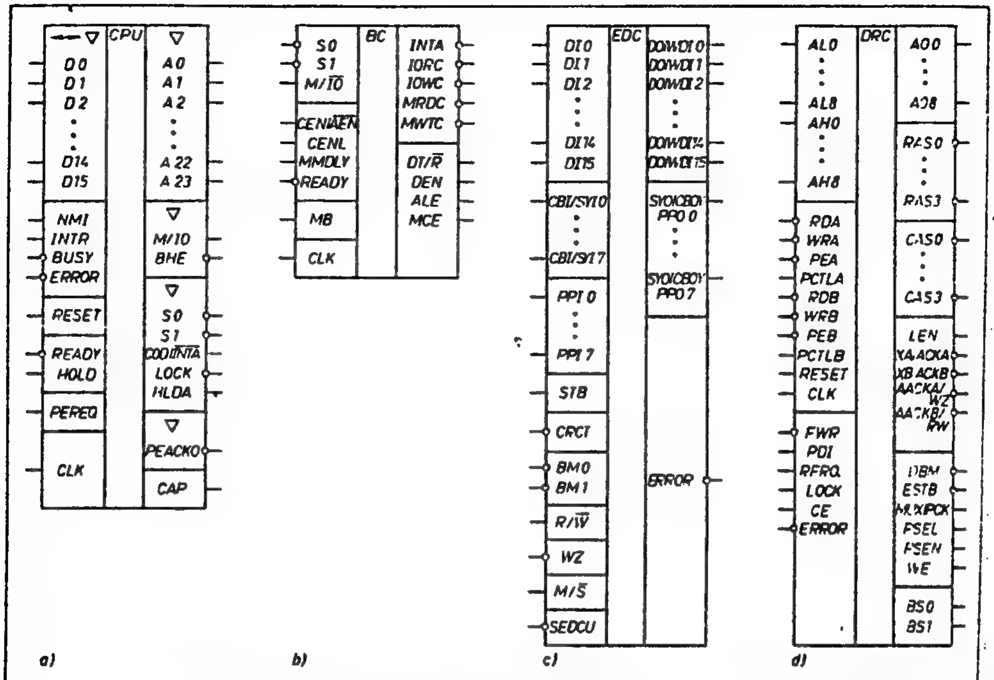


**Figure 7. Proposed Symbols for the U 80600 Microprocessor System Manufactured by VEB Mikroelektronik "Karl Marx," Erfurt. a) U 80601 Microprocessor; b) U 80606 Bus controller; c) U 80608 Error detection circuit; d) U 80610 DRAM controller**

the SY 625/0.5 (50 V), SY 625/1 (100 V), SY 625/1.5 (150 V) and SY 625/2 (200 V). The RMS forward current $I_{F(RMS)}$ = 43 A, the average forward current is 28 A, and the maximum surge current is given as 420 A. Additional technical specifications are forward voltage $U_{FM}$ = 0.95 V, reverse recovery time </= 50 ns, peak reverse current 3 mA, forward voltage $U_{FM}$ = 0.85 V, internal thermal resistance </= 1 K/W.

The **VEB Mikroelektronik "Karl Liebknecht," Stahnsdorf**, introduced the **SY 710** and **SY 715 Schottky diodes**. Unfortunately, we were unable to find information on their technical specifications.

The **SU 391, SU 392 and SU 393 NPN silicon power transistors**, also made in Stahnsdorf, are housed in a TO 218 plastic package, and were designed for use in switching regulators, inverters and DC voltage transformers. These devices expand the current product range (SU 386 through SU 390) in the direction of increased current handling capability. The values for the collector current $I_{Csat}$ of the devices are as follows: 20 A (SU 391), 15 A (SU 392) and 10 A (SU 393); the base current values lie between 8 and 4 A. The values for collector-emitter voltage $U_{CEO}$ are </= 90, 125 and 250 V; $U_{CEV}$ </= 125, 160 and 300 V. Multiple epitaxial technology has allowed the achievement of exceedingly low collector-emitter saturation voltages: $U_{CEsat}$ </= 1.2 V (SU 391 and 392), and 0.9 V (SU 393). All three devices have a maximum fall time of 0.8 µs.

The new **U 84 C 00 DC CMOS microprocessor system** made by **VEB Mikroelektronik "Karl Marx," Erfurt**, is pin- and function-compatible with the U 880 microprocessor system. This new system contains the following semiconductor devices: **U 84 C 00 DC (CPU), U 84 C 20 DC (PIO), U 84 C 30 DC (CTC)** and **U 84 C 40 DC (SIO).** The suffix "...DC 02" indicates that the clock frequency is 2.5 MHz; a "...DC 04" model with a clock frequency of 4.0 MHz is also available. Both families have stand-by capability; the 2.5 MHz family includes a version without this feature which has the suffix "...DC 02-1." Typical current consumption values are 15 mA (CPU), 2 mA (PIO), 3 mA (CTC) and 7 mA (SIO); in the stand-by mode this value drops to </= 10µA. All of the ICs in this system require a supply voltage of 5 V and a 5 V single-phase clock pulse. All standard devices can be used as memories. The minimum command execution time of the CPU is 1.6 µs with a clock frequency of 2.5 MHz; this value drops to 1 µs for a frequency of 4 MHz.

The fast **16-bit U 80600 microprocessor system** has been designed primarily for use in personal and industrial computers. It can also be used at the workplace and in communications systems where high processing speed is desirable. The **U 80601 microprocessor** can be used in multiuser and multitasking systems. In terms of software, it is upwardly compatible with the Soviet Type KP 1810 BM 86, although it is up to six times as powerful, depending on application. It can be used in direct address mode, as well as in protected virtual mode. Both modes can be programmed using the instruction set of the KP 1810 BM 86. The clock frequency is 16 MHz (U 80601-1), and the address range is 1 GB per task, which meets international PC standards. The corresponding **bus controller** is the **U 80606**, which makes the

command and control signals available to the bus systems, thereby increasing the performance of the microprocessor. Timed commands are issued, and meet all requirements of multibus and MMS 16 systems. Two operating modes are possible: MMS-16-compatible and fast local bus cycles. The IC has one clock pulse input and 8 status and control inputs as well as 5 command outputs and 4 control outputs. The latter output a 32 or 16 mA driver current at the L level. The **U 80608** integrated circuit is used for **error detection and correction** (EDC). It can process 8- or 16-bit data and a maximum of 8 check bits. If five U 80608s are cascaded, the width of a data word increases to 80 bits. All 1-bit errors are detected and corrected; 2-bit errors and many multiple-bit errors are detected only. Error detection requires max. 52 ns, and in 16-bit systems error correction takes a maximum of 67 ns. A sub-version U 80608-2 is also available, however this version cannot be cascaded. The **U 806 10 DRAM controller** (DRC) is programmable, and is designed to drive dynamic read/write memories which have a capacity of 16 K, 64 K or 256 Kbits. The address space (without external drivers) comprises 2 MB of usable area, and five refresh modes are available.

All ICs in the U 80600 family are encapsulated in PLCC 68 packages with the exception of the bus driver chip, which is packaged in a 20-pin DIP.

It should be mentioned at this juncture that in the GDR, the percentage of integrated circuits in surface-mounted packages (SO and PLCC packages) has increased. Happily, plastic leadless chip carrier packages (PLCCs) seem to have come into general use, particularly for larger-scale integrated circuits such as those just mentioned above.

The **VEB Mikroelektronik "Anna Seghers," Neuhaus** introduced the **silicon planar epitaxial AF transistors SCE 535, SCE 537**, and **SCE 539** (NPN), as well as the PNP transistors **SCE 536, SCE 538 and SCE 540**. These transistors were designed for hybrid technology and for surface-mounted applications, thus they are housed in SOT 89 packages. The technical specifications of these transistors are coordinated among all transistors in accordance with the sequence of zones, and the transition frequency is 50 MHz.

**Table 2. Technical Specifications of the Silicon Planar Epitaxial AF Transistors SCE 535 through SCE 540 Manufactured by VEB Mikroelektronik "Anna Seghers," Neuhaus**

| | SCE 535, | SCE 537, | SCE 539 |
|---|---|---|---|
| | SCE 536 | SCE 538 | SCE 540 |
| $U_{CBO}$ in V | 45 | 60 | 100 |
| $U_{CEO}$ in V | 45 | 60 | 80 |
| $U_{EBO}$ in V | 5 | 5 | 5 |
| $I_C$ in A | 1 | 1 | 1 |
| $I_B$ in A | 0.2 | 0.2 | 0.2 |
| $P_{tot}$ in W | 1 | 1 | 1 |
| $U_{CEsat}$ in mV | </= 500 | </= 500 | </= 500 |
| $h_{21E}$ | > 25 | > 25 | > 25 |

The **n-channel MOSFET tetrode transistors SME 992, SME 994** and **SME 996** are well suited to applications where space is limited in preliminary and mixer stages of radio and television tuners, in antenna amplifiers and in optical waveguide receiver modules. They are depletion-type transistors and have integral diode-protected gates. The SME 992, SME 994 and SME 996 operate in the FM, VHF and UHF ranges, respectively. For all transistors, the drain-to-source voltage is max. 20 V, the maximum permissible current from both gates to the source connection is 10 mA and the power dissipation is 200 mW. Additional technical specifications include $Y_{21S}$ >= 20 mS (SME 992) and >= 15 mS; gain >= 15 dB; noise factor F </= 2.5 dB (f = 200 MHz, SME 992), </= 2.8 dB (200 MHz, SME 994) and </= 3.9 dB (800 MHz, SME 996).

The **VFE 15 GaAs transistors** are designed for working frequencies up to 12 GHz and are housed in metal/ceramic TO 120-type cans. The **VF 15 X** was introduced as a un-encapsulated version of the VFE 15. The GaAs FETs are broken down into six groups, depending on their noise factor and gain. Some of their technical specifications are as follows: $I_C$ = 100 mA, $U_{DS}$ = 5 V, $U_{GS}$ = -5 to 0.5 V, $P_{tot}$ = 350 mW, pinch-off voltage = -4 V, rise time = 20 ms. The average dimensions of the VF 15 X chip are 470 µm x 370 µm x 150 µm, and the dimensions of the bonding pads for the gate and drain are 60 µm x 60 µm; those of the bonding pads for the source are 120 µm x 60 µm. The bonding pads are made of layers of Ti/Pt/Au. Please refer to the article which begins on page 397 of this issue which presents these GaAs field-effect transistors in more detail.

**Table 3. Dynamic Characteristics of the VFE 15 GaAs Transistors Manufactured by VEB Mikroelektronik "Anna Seghers," Neuhaus**

| | Maximum | Minimum |
|---|---|---|
| | Noise Factor | Gain |
| | F in dB | G in dB |
| VFE 15-18 | 1.8 | 9.0 |
| VFE 15-20 | 2.0 | 8.5 |
| VFE 15-23 | 2.3 | 8.0 |
| VFE 15-27 | 2.7 | 7.0 |
| VFE 15-32 | 3.2 | 6.5 |
| VFE 15-37 | 3.7 | 6.2 |
| VFE 15 X | 3.7 | 6.2 |

The **VEB Werk fuer Fernsehelektronik, Berlin** also introduced a series of interesting new products. The **L211 C CCD matrix** uses the column-to-column transfer principle and has a resolution of 190 x 244 pixels. The matrix has a column-by-column anti-bloom feature and an output amplifier. The matrix is housed in a 24-pin ceramic package based on inch dimensions. It requires the three operating voltages $U_{DD}$ = 13 to 20 V, $U_{AB}$ = 8 to 16 V and $U_{SF}$ = 5 to 14 V; the saturation voltage is at least 100 V. Light and dark signal fluctuation is given as

</= 20 percent, while sensitivity S is specified as 0.5 to 1.8 V $cm^2/\mu J$. The horizontal transport clock frequency is max. 7.2 MHz.

The **L220 CA** is a **TV-compatible CCD matrix** which meets CCIR specifications. It contains 294,912 picture elements (512 horizontal by 576 vertical). Technologically speaking, it is roughly on a par with the 256 Kbit DRAM. Data is read out field by field, and the matrix has a column-by-column anti-bloom feature. The image area is 8.7 mm x 6.6 mm. The matrix operates in combination with a special **U 2200 PC triggering IC** which was also developed in the Werk fuer Fernsehelektronik. The driver IC generates the control pulses, the pulses for mixing the composite black-and-white or color video signal (PAL), and offers various synchronization options. Column-by-column correction of matrix errors is possible, as is the changeover of the matrix from frame to field mode. Because there is a pulse interface with the outside environment of the matrix and many internal assemblies can be accessed from the outside, the driver IC can be adapted to other video applications. The inputs and outputs are CMOS- and TTL-compatible, and are protected from static electric charges. Technical specifications of the matrix include operating voltages of $U_{DD}$ = 14.5 to 15.5 V and $U_{AB}$ = 11.5 to 12.5 V, saturation output voltage $U_{SAT}$ </= 200 mV, sensitivity >= 1 V $cm^2/\mu J$, output impedance >= 1 kΩ, transport clock frequency </= 10 MHz, response range 1000:1, sensitivity range 350 to 1100 nm, 24-pin ceramic DIP. Technical specifications of the driver IC include $U_{DD}$ = 5 V, basic clock frequency as per the CCIR standard = 9.875 MHz with a pulse duty factor of 1:1, color oscillator frequency 8.86 MHz (double the PAL frequency), power dissipation 0.5 W, 64-pin PLCC package. Both devices are designed for use in small black-and-white video cameras in monitoring, measuring and automation applications. Their advantages over classical video tube cameras are lower camera weight, considerably reduced power consumption, greater sensitivity range (near infrared to far ultraviolet), insensitivity to magnetic fields, shock and vibration, and finally the fact that no change in parameters occurs as a result of overexposure.

The **MB 126 optocoupler** is a miniature all-plastic reflex coupler. Its technical specifications include forward DC current $I_{F)}$forward voltage $U_F$ </= 1.5 V, reverse voltage $U_R$ </= 3 V, reverse current $I_R$ </= 100 µA, collector-emitter dark current $I_{CEO}$ </= 100 µA, total power dissipation $P_{tot}$ </= 100 mW.

Other **couplers** introduced were the **MB 130, MB 131, MB 132, MB 133, MB 134** and the **MB 135**. The MB 131, MB 132, MB 133 and MB 134 replace the MB 104/6, MB 104/4, MB 105/6 and MB 105/4 couplers. They comprise an infrared emitting diode (IRED) as the transmitter and an NPN silicon planar transistor as the receiver. The base connections are brought out on all but the MB 133. Technical specifications for all types are reverse voltage $U_R$ = 6 V, forward current $I_{F)}$= 200 mW, propagation factor = 40 to 480 percent (40 to 320 percent for the MB 135), rise and fall time = 10 µs. The collector-emitter voltage is 35 V (MB 130), 70 V (MB 131 through MB 134) and 90 V (MB 135). The following values are given for the test isolation voltage: 2.8 kV (MB 130), 4.4 kV (MB 131 and 132), 5.3 kV (remaining couplers). All of these optocouplers are packaged in 6-pin DIPs.

The **MQE 10 analog/digital converter module** consists of a hybrid integrated ADU, which works according to the dual-slope integration principle (C 520), a BCD seven-segment decoder and a three-digit numerical display (red, with 12.7 mm high numerals). The module processes input voltages of from -90 to 990 mV which are displayed with an accuracy of within 1 mV, and which are available in BCD form for further processing. The converter module also has a control input for varying brightness under fluctuating ambient light conditions. Technical specifications include $U_{CC}$ = 4.5 to 5.5 V, linearity error = 0.1 percent +/-1 digit, current consumption 20 to 30 mA (without display of measured values) and 100 to 180 mA (with display of measured values), average luminous intensity 150 to 500 µcd, luminous intensity ratio 2.0 to 3.0, common-mode range </= +/-200 mV, common-mode rejection >= 40 dB, conversion rate 2 to 7 measurements/s (slow) or 50 to 160 measurements/s (fast); in hold mode, the last measurement is stored.

The VQH... family of hybrid numeric and flat panel displays, which had already been introduced at the 1988 Leipzig spring trade fair, now bears the new designation **MQH ...** by reason of the different materials used for each device; the serial number parts of the old designations were not changed. New products are the **light emitter flat band displays MQH 201, MQH 202, MQH 601** and **MQH 602**, which are designed for universal applications. They each comprise 12 LEDs and an A 277 X hybrid integrated driver circuit. These displays use LEDs with a rectangular 1.35 mm x 4 mm light emission surface. The display modules can be mounted continuously one after the other to produce a contiguous, uninterrupted display of any desired length, and are used for the digital and quasi-analog display of measured values in electronic consumer goods and in measurement equipment. The type designations indicate the LED color and operating mode:

MQH..1—> segment mode

MQH..2—> print mode

MQH 2..—> 12 green LEDs

MQH 6..—> 8 green and 4 red LEDs.

Information can be displayed with zero symmetry in both the band and dot modes. The technical specifications include $U_{CC}$ = 5.5 to 18 V, $I_{CC}$ </= 10 mA, control voltage $U_{St}$ = 0 to 6.2 V.

The **VQ 175 GaAlAs infrared emitter diode** is housed in a can-shaped package, and can be connected to an optical waveguide via a non-permanent connection. Technical specifications include $I_F$ </= 100 mA, $U_F$ </= 2.2 V, $I_R$ </= 10 µA, $U_R$ </= 2 V, coupled radiated

optical power >= 25 μW, continuous radiated power >= 1 mW, pulse rise time </= 30 ns, wavelength of maximum radiation is 850 nm.

## CSSR

The **KCJ 10 field-effect transistors** introduced by **Tesla Piestany** have a gate protection diode and an internal 1.1 kΩ resistor in the source input line. They are primarily designed for use in microphone preamplifiers. Technical specifications include $U_{DS}$ </= 40 V, drain current = 50 to 450 μA with $U_{GS = 0 \text{ and } U_{GS}}$ = 1.5 V, drain current </= 1.3 x (50 to 450 μA) with $U_{DS}$ = 0 and $U_{DS}$ = 40 V, gate current </= 1 μA, rise time $Y_{21 >= 100 \mu S \text{ with } U_{GS}}$ = 0 and $U_{DS}$ = 1.5 V, noise voltage </= 40 μV/(Hz)$^{-1/2}$.

The **MHB 208** IC is designed for use in electronic polyphonic **keyboard instruments**. It is made using n-MOS polysilicon gate technology, and is packaged in a 40-pin plastic DIP. It works with a 61-key keyboard, and accepts all pressed keys. Two keyboard modes are possible: solo with 61 keys or 44-key solo with 17-key accompaniment. In this second mode, chords can be generated automatically. Several ICs can be hooked up in parallel and synchronized using the reset function. Separate analog outputs are provided for each part (solo and accompaniment); square-wave bass outputs are also provided which have a pulse duty factor of 50 percent). This synthesizer chip is designed for universal use, and is pin- and function-compatible with the M 208 made by SGS. Technical specifications include $U_{DD}$ = 12 V +/-5 percent, $I_{CC}$ </= 45 mA, $U_{IH}$ = 4 to 18 V, $U_{IL}$ = 0 to 0.6 V, output impedance = 300 Ω, $U_{OH}$ = ($U_{DD}$ - 0.4 V) to $U_{DD}$, $U_{OL}$ </= 0.4 V, input frequency >= 800 kHz (1000.12 kHz typ.), rise and fall time = </= 40 ns.

The MOS circuit **MHB 576** is designed for **phase-switching triacs.** It is primarily designed for controlling the brightness of AC light sources (incandescent lamps, for example); this is done via the opening angle of the triac. The output control pulse depends on the status of an internal 7-bit downcounter which the user can control via two control inputs and a 7-bit ring counter. Technical specifications include $U_{DD}$ = 13.5 to 16.5 V, $I_{DD}$ </= 1.4 mA, $U_{IL}$ </= 0.8 V, $U_{IH}$ >= 6.0 V, working frequency >= 45 Hz, width of output pulse = 40 μs, rise time = 10 μs, integrating capacitor = 47 nF; the IC is packaged in an 8-pin DIP.

## Hungary

The Hungarian **microelectronics firm MEV, Budapest**, included in its exhibit the **1801 VP 1 n-MOS gate array** which contains 1500 gates and was developed together with the USSR. The joint venture **Intermos** was founded for this purpose. The Soviet Union supplies the semifinished wafers, and the circuitry is then applied in Hungary in accordance with the customer's requirements. The chip comprises 520 basic cells which can be combined to form 1560 different applications circuits. There are an additional 80 cells which can be used to form buffers and I/O modules. The inputs and outputs are TTL-compatible. Technical specifications include $U_{CC}$ = 4.75 to 5.25 V, $I_{CC}$ </= 180 mA, $U_{OL}$ </= 0.4 V, $U_{OH}$ >= 2.7 V, $I_{OL}$ </= 4 mA, $I_{OH}$ </= 1 mA, $C_{IO)}$pF, clock frequency </= 8 MHz. MEV burned down several years ago, and for this reason the Budapest semiconductor factory has not yet resumed the production of integrated circuits, although some discrete components are again being made. It is not surprising, then, that at the present time MEV must turn to foreign suppliers for assistance.

### Passive Components

The **GBR 18** and **GBR 19 remanent relays** made by the **VEB Elektro-Apparate-Werke [Electrical Equipment Plants] Combine "Friedrich Ebert," East Berlin**, can be directly connected to integrated circuits with push-pull or tristate output stages. They generate a switching current of 10 A at 220 VAC. Different types of pulse drive are possible, depending on circuit design, thereby allowing the state of a relay to be stored if desired, for example. The user is also free to decide which state will be assumed in the event of a power failure. One IC can drive up to eight relays. The GBR 40 AC relay has a minimum contact gap of 3 mm; an 8 mm leakage and air gap, and a dielectric strength of 4 kV between the contact and the coil. It can switch a load of 16 A at 220 VAC, but can be used with voltages up to 360 V.

The **VEB Elektronische Bauelemente [Electronic Components] "Carl v. Ossietzky," Teltow**, introduced **Series CWF 315-1206-1 chip resistors** for general applications. These components can be used on SMD-compatible circuit boards and in hybrid integrated circuits on a substrate. The resistors consist of a ceramic substrate on which the resistive layer is mounted; this thin film is protected by a passivation coating. According to the manufacturer, the technical specifications meet the IEC Recommendations. The dimensions are 3.2 mm x 1.6 mm x 0.6 mm. The width of the contact strip is 0.5 mm, weight is 0.01 g, nominal power dissipation is 0.125 W, and the critical voltage is 75 V. These resistors are made in Series E 6, E 12, E 24 and E 48. In addition, an integrated-circuit jumper (resistance 0) is available. They are packaged in bulk, or in cardboard or blister strips.

The **MSF 38.9 R surface-wave filter** was new this year, and is a vestigial side-band filter for IF modulators (CCIR). The reference frequency is 37.4 MHz, insertion loss is (21 +/-3) dB, attenuation is (3 +/-2) dB at 39.65 MHz, >= 19 dB at 31.9 MHz (adjacent picture carrier), >= 20 dB for the 40.4 MHz and 1.4 MHz adjacent sound carriers. Ripple in the band-pass region is +/-0.75 dB (34.4 to 38.9 MHz).

The **FIL 058/350 E 31 four-element metal foil strain gauge** is intended for use in weighing equipment and precision weighing equipment requiring calibration. The gauges use NiCr as the foil material, which is approximately 5 μm thick and has a width of 5.4 mm and an active length of 5.8 mm. The measuring grid is mounted on a substrate made of cellulose-reinforced epoxy resin.

Technical specifications include nominal resistance 350 Ω +/-1.75 Ω; the tolerance can be tightened to +/-0.5 Ω if desired. Feed voltage is 7.5 for the individual strain gauge elements, or 15 V for all four; nominal strain is +/-1.6 x $10^{-3}$; insulation resistance is > $10^{10}$ Ω.

The **VEB Kontaktbauelemente [Contact Components], Luckenwalde**, developed a **range of plug connectors with slotted and roll-pressed clamping features** which are suitable for automated processing. These plug connectors are used for the internal wiring in electronic assemblies and devices, for removable connections between the circuit board and the leads connected to it. In the case of the slotted clamping connector, contact is made between the wire and the contact of the female edge connector without insulation removal. The average service life is 50 insertions, and the contacts are 2.5 mm apart. Operating current </= 5 A at 20°C or </= 3.5 A at 70°C, contact resistance </= 10 mΩ, insulation resistance is $10^{11}$ Ω.

The **VEB Lokomotivbau - Elektrotechnische Werke [Locomotive Construction and Electrotechnical Plants] Combine "Hans Beimler," Henningsdorf**, is the GDR's only supplier of copper laminated printed circuit board material, and alone meets the demand for this product, although this is not generally known. A new product is the **discoloration-proof copper foil** with a nominal thickness of 0.035 mm. It is used in the manufacture of copper laminated base material for microelectronic circuit boards, and prevents the thermal discoloration of the surface of the laminate caused by the pressing process, thereby eliminating the need for additional cleaning steps. The new foil can be used with the FR-2, FR-4 and G-10 laminates in accordance with NEMA.

## Computer Technology

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[Article by W.E. Schlegel: "Leipzig Spring Trade Fair 1989: Effects"]

[Excerpts]

### GDR

The exhibit focused on a large quantity of computer-related equipment and accessories. These devices were demonstrated as used in typical rationalization applications.

A first-rate product made by the **VEB Robotron Combine** is the **K 8919 11 interactive graphics terminal**. It is a high-performance unit for 2-D graphics intended for use with powerful CAD/CAM stations based on 32-bit computers such as the K 1840. In addition, of course, it can be coupled to a wide variety of ESER data processing systems, as well as other computer-based devices.

The main unit comprises a fast graphics processor which has eight 1280 x 1024-bit pages of memory, each of which outputs to a correspondingly high resolution color monitor. The control center of the unit is the master processor which coordinates all of the subassemblies and connected devices. The terminal can be connected to a host computer via a DMA-compatible parallel interface or a serial IFSS or V.24 interface. The parameters for data transmission to the host computer can be set via a keyboard or by direct commands issued by the host computer. The parameters are stored in a battery-backed CMOS memory, and are thus retained even after the unit is switched off. The fact that they can also be downloaded from a user diskette ensures a high degree of flexibility and a wide variety of applications. This makes it possible to quickly switch applications. The data transmission rate can be set within the range of 50 to 19,200 baud. Its basic operating modes are the EDIT and TRM modes, whereby the TRM mode is the actual graphics mode. Control commands are issued by the computer to switch from one mode to the other. In the setup mode it is possible to work off-line with a limited number of functions. High efficiency in a wide variety of applications is ensured by the availability of the most important basic graphics functions: vectors, graphics text, markers and panels. In addition, signal processing, the surface [mounted] concept and the use of windows provide ease of use. Three serial ports can be used to attach additional equipment such as the K 6405.10 graphics tablet, a variety of printers, etc. The terminal also has two diskette drives. These drives are supported as logic units by the terminal file system, which allows segments or entire screens to be saved and loaded, as well as sequences of commands stored on diskette to be processed.

The **Erica electronic 3006** made by the **VEB Robotron-Optima Bueromaschinenwerk [Office Machines Plant], Erfurt**, is a compact electronic typewriter which can operate at a speed of 10 characters per second. The paper feed mechanism is designed to accommodate a maximum paper width of 305 mm while allowing a maximum text width of 254 mm. Various fonts, each with 100 characters, are available; the typewheels come in "drop-in" cassettes. The Erica electronic 3006 allows single, one-and-a-half and double line spacing with 10, 12 or 15 characters per inch. The keyboard has 44 typing keys as well as function keys for one-half forward and reverse line feed, backspace, correction, carriage return with line feed, and spacebar. Other functions include the relocate function which is active across the whole page, micro-line feed, automatic carriage return, half-backspace, horizontal and decimal tabs, tab matrix, indentation, centering, right-justification, boldfacing, automatic underlining and grouped style. The code key is used to implement special characters and functions, and the mode key controls memory functions and implements functions which make the typewriter easier to operate. The typewriter features automatic paper insertion and ejection. The internal text memory has a capacity of 8 KB, and the correction memory can hold an

entire DIN A4 page; the on-board battery is said to allow data retention for approximately 5 years. The machine has a 16-character display. Both the lift-off and cover-up types of correction tape with a capacity of 2000 characters can be used. Optional Commodore, Centronics or V.24 interface cartridges are also available, through which the typewriter functions as a printer when connected to a computer. Its dimensions are 130 mm x 430 mm x 370 mm, and it weighs 7.4 kg.

The **VEB Robotron-Buchungsmaschinenwerk [Accounting Machines Plant], Karl-Marx-Stadt**, has introduced a new 6000-Series typewriter, the **Erika 6007 compact electronic typewriter**. It also has a set of 100 characters, and can operate at a maximum speed of 13 characters per second. The S 6007 has an internal 400 character text memory, a 256-character correction memory and a 32-character keyboard buffer. The code key is used to implement special characters and functions. The keyboard has 48 typing keys and function keys for the 30-position decimal tabulator, half-line feed, automatic carriage return, automatic paper insertion and ejection, stencil mode, centering, right-justification, grouped style, stop code, left- and right-hand margins, margin release, automatic underlining and indentation. A second typewheel with ASCII characters is offered as a second character set. The typewheels and ribbons come in cassettes. Both the lift-off and cover-up types of correction tape can be used. All of the 6007 models have a system interface to which Commodore, Centronics or V.24 interface modules can be attached by a 4000-character expansion module with data retention or by an accounts receivable module. Power consumption is 50 W, dimensions are 482 mm x 417 mm x 135 mm; the unit weighs 9.2 kg.

The **K 6416 compact plotter** is a continuous-roll plotter for the ISO A3/A4 and ANSI A/B formats. The plotter accommodates white paper, transparent drawing paper and drawing film, including overhead transparency film. It can use ink pens with fiber or plastic points, as well as ink capsules (as per DIN 32 867, Style A) as drawing tools. The rotary tool magazine can simultaneously hold eight drawing tools of different colors or tools with different line widths for programmed tool changes. The paper transport rollers, tool carriage and tool magazine are driven by stepping motors. The maximum drawing area is 420 mm x 297 mm; the maximum drawing speed is 300 mm/s. The plotter achieves a resolution of 0.1 mm with a relocation accuracy of 0.2 mm. It is software-compatible with internationally popular PC plotters, in particular the HP 7475 made by the American firm of Hewlett Packard. Like these, the K 6416 also has 19 character sets available, including a Cyrillic alphabet character set. The CCITT V.24, IFSS, IEEE 488 and Centronics interfaces are available. Outside dimensions are 570 mm x 370 mm x 140 mm (W x D x H). It weighs 6.7 kg, and has a power consumption of 35 W.

The **VEB Robotron Messelektronik [Measurement Electronics] "Otto Schoen," Dresden**, has developed the **A 5105 educational computer** which is intended primarily for scholastic applications. It comprises the K 1505 computer, the K 5651 diskette drive and the K 7222 monitor which are electronically and mechanically connected to one another. The microprocessor is the U 880, and the video controller chip is the U 82720. The basic configuration includes a program memory of 64 KB, 64 KB of user-addressable RAM and 128 KB of video storage. Various device interfaces permit the connection of printers, plotters, devices for experimental applications, an auxiliary floppy disk drive unit with a maximum of two drives, a cassette recorder, a color monitor with an RGB or composite video input, and two joysticks; local area networks can also be set up. The system has two free expansion slots. Two operating systems are available which permit a wide variety of applications; these systems use diskette and file formats which are standard in SCP. The SCPX 5105 is fully compatible with the SCPX 1715. The large video memory allows the user to work with up to 16 text and 6 graphics images. Sixteen foreground and 8 background colors are available with a color monitor. The system has a flat keyboard which has an additional 10 function keys for ease of use. The screen can show 25 lines of 40 characters or 25 lines of 80 characters in text mode. The graphics mode has a resolution of 640 x 200 picture elements. The computer is capable of sound reproduction in three channels of eight octaves each.

The **P 8000 compact** made by the **VEB Elektro-Apparate-Werke [Electrical Equipment Plants] Combine "Friedrich Ebert," Berlin-Treptow**, is the most recent version of its successful, several year-old P 8000 programming and development system. The tower design is retained in the new system, and its basic dimensions are 420 mm x 260 mm x 395 mm; the system has five free expansion slots for the wide variety of available hardware modules, thereby making it capable of running a broad spectrum of applications. Up to seven terminals can be connected, and various different computer configurations can be set up using 8 or 16 bit technology, or using a WDOS adapter. The internal memory capacity is 1 MB, upgradeable to 4 MB to handle a a wide range of applications. The system comes with one or two 44 MB hard disk drives as external storage devices, and two 5.25" floppy disk drives. The system also features a battery-backed on-board clock and an EPROM programmer as standard equipment. The system can accommodate four serial V.24 interfaces at the same time, of which two are IFSS interfaces. The comprehensive software package contains the four powerful, internationally-known operating systems Wega (UNIX-compatible) for the 16-bit computer section, WDOS for the WDOS adapter, and UDOS and OS/M for the 8-bit section. A broad assortment of utility programs, higher programming languages and applications packages offer multiuser and multitasking features, hierarchical file management, process management, text processing and computer coupling. WEGA-REMOTE can be used to set up a star-shaped computer network in conjunction with personal computers.

The **VEB Automatisierungsanlagenbau [Automation Systems Design], Berlin**, introduced a new approach to industrial process automation with its **ICA 700 industrial automation computer**. This is an self-contained, powerful, user-friendly system which is capable of performing tasks of an industrially-oriented personal computer and a stand-alone cabinet-style automation system, all the way up to an automation system network. This new dual-computer configuration joins the powerful performance of a personal computer with the advantages of sophisticated real-time systems, and is unaffected by heat, cold, dust and vibration.

The inclusion of a 16-bit microprocessor system ensures program compatibility with XT- and AT-type computers. The use of modular assemblies in accordance with IEC standards for automation allows the system to be smoothly integrated into the most divergent process control configurations. The system incorporates standardized interfaces through which the ICA 700 family can communicate with equipment made by other manufacturers. At the present time, two system configurations are available: the ICA 710.20 housed in an industrial cabinet and the desktop model ICA 710.30.

**Poland**

The **Elwro Wroclaw** Company introduced the **ELWRO 801 AT personal computer**. As the name indicates, this system is an AT-type computer which uses the 80286 microprocessor. Because the clock frequency can be toggled back and forth between 6 and 8 MHz, its performance figures are variable. It also supports the 80287 math coprocessor. The computer comes with 512 KB of RAM, expandable to 2 MB; external storage includes 360 KB or 1.2 MB 5.25-inch floppy disk drives and a 20 MB hard disk drive. It has five expansion slots for user versatility. Centronics and RS 232-C interfaces, a multiple-access plug-in unit, graphics adapters and SDLC adapters are available, as are both monochrome and color monitors. Available software includes MS-DOS 3.3, GW-BASIC and the integrated package PC-WORKS, which includes text processing, databases, graphics and other problem-oriented program systems.

**Hungary**

The **VT 180** is the latest addition to the VT 110 and VT 160 personal computers made by **Videoton**. This new system differs from its predecessors in that its processing speed and on-board memory have been dramatically increased. In terms of software, it is fully compatible with the VT 160. Its increased performance, however, makes it suitable for a much broader range of applications. With its ability to process large amounts of data more quickly, it approaches the level of electronic data processing system applications. The VT 180 is based on the 80386 32-bit microprocessor system. Computing speed can be further enhanced through the use of the 80387 math coprocessor. The tower design provides room for a number of additional modules. The motherboard has expansion slots for four AT-type cards and one XT card. Two memory expansion configurations can also be installed, thereby increasing the on-board memory from 2 MB to 16 MB. A single controller board handles two floppy disk drives or streaming tape drives and two hard disk drives. The MDA controller and monitor provide 720 x 348 pixel monochrome graphics and 80 x 25 characters in alphanumeric mode. The display control unit also incorporates a Centronics printer interface. The CGA color graphics adapter board contains the controller for a color monitor and a 16 KB memory. In graphics mode, the following colors and resolutions are supported:

2 colors, 640 x 200 pixels 4 colors, 320 x 200 pixels 18 colors, 160 x 100 pixels.

In alphanumeric mode, 25 lines and 80 characters are supported. The EGA adapter contains the color monitor controller with increased resolution:

2 colors, 640 x 350 or 720 x 348 pixels 16 colors, 640 x 350 or 640 x 200 pixels.

Alphanumeric operation is identical. The computer comes with MS-DOS 3.2 and GW-BASIC. The user can choose among a wide variety of utilities and applications.

**Bulgaria**

The Bulgarian economic association **Microprocessor Systems** in Pravec introduced the **EC 1839 (Pravec 16A) personal computer**, an XT-compatible computer which can be used for various types of office work and for scientific and technical tasks. It is based on the 8088 microprocessor which can be supplemented if desired by the 8087 math coprocessor to increase calculating speed. It has a maximum of 640 KB of on-board memory, and can support two 360-KB 5.25-inch floppy disk drives and one 10 or 20 MB hard disk drive. It can be combined with a monochrome monitor with a graphics resolution of 640 x 200 pixels or a color monitor with a resolution of 320 x 200 pixels. It also has serial and parallel interfaces for connection of a variety of peripherals. Network interface controllers allow the creation of ring- or bus-type local area networks. The DOS 16 operating system is available. Various programming languages such as BASIC, C, FORTRAN and assembly language allow selection of a language to fit the application in question.

The **EC 5027.M** represents the newest of the ESER magnetic tape devices. It has a tape speed of 3 m/s and a recording densities of 63 and 246 bits/mm, thereby achieving data transmission rates of 189 and 768 MB per second. The unit is GCR-compatible, and offers storage capacity of up to 18 MB per tape reel. Rewind time is 60 s. The guaranteed error rate is better than 2048 x $10^{-5}$. Power consumption is approximately 1.5 kW.

**Romania**

The **Junior XT**, exhibited this year, represents the continuation of the line of personal computers made for the past several years by the **Factory for Peripheral Devices**, Bucharest. As its name suggests, it is an XT-compatible computer based on the 8086 microprocessor. It has 256 KB of on-board memory, which can be expanded to 640 KB. Two 5.25-inch floppy disk drives and a hard disk option are available as external storage media. The user can choose between monochrome and color monitors to complete the system. The computer has eight XT-compatible expansion slots for additional adapters which allow it to run a wide variety of applications. The manufacturer also sells a math coprocessor, hard disk adapter, SDLC communications adapter, magnetic tape adapter, and RS 232-C and Centronics interfaces. The system will also support several printer types, plotters, modems and various graphics peripherals. The system comes with an operating system which is compatible with MS-DOS, and includes compilers for FORTRAN, COBOL, Pascal, BASIC, LISP, Edison, C, FORTH, Logo and Smalltalk. The complete user software packages include Wordstar, dBASE III, Calcstar, Infostar, Reportstar, Datastar and Auto-CAD.

The **VDT 52 S video terminal** made by **ICE Felix, Bucharest**, is intended for alphanumeric and graphics applications. The 12-inch screen (monochrome green) displays 24 or 25 lines of 80 or 85 characters each in alphanumeric mode. In graphics mode, a resolution of 512 x 256 pixels is supported. An RS 232-C interface allows the unit to be connected to any host computer. An additional RS 232-C interface allows connection of a graphics printer. In addition to system-specific printing applications, graphics and alphanumeric screen dumps are possible. The terminal is fully compatible with the VT 52 and the Tektronix 4012. The power consumption is 70 W; monitor dimensions are 324 mm x 343 mm x 368 mm; the unit weighs 11 kg.

**Yugoslavia**

The **Adria 32-bit super minicomputer** is the newest member of the Delta/V computer family made by **Iskra Delta Computers, Ljubljana**. Like its predecessors, it is intended for use in a wide variety of industrial applications, including real-time processing, office automation, CAD/CAM tasks, etc. Although small in size, its use of cutting-edge technologies makes it a powerful machine. It requires no special environmental conditions for use, and can be used in a normal office. The 32-bit central processing unit contains an additional floating-point processor. The computer has 1 MB of internal memory, and can be upgraded to 8 MB. It has a built-in 335 MB hard disk. Data can be backed up using the streaming tape drive module. Up to 16 CRT terminals can be connected to the computer for system operation. The system comes with the tried and proven Delta/V operating system.

The same manufacturer also introduced the AT-compatible **Partner/AT** personal computer. This 16-bit microprocessor system operates at clock frequencies of up to 12 MHz. This level of performance can be increased even more through the use of a coprocessor. The basic system comes with a battery-backed timer card with real-time clock and calendar. Maximum internal memory is 1 MB. The 1.2 MB floppy disk drives and the hard disk drives with a capacity of 40 or 80 MB offer sufficient storage space for the most demanding applications. In addition, 20 or 40 MB streaming tape drives are available. Various graphics adapters are available to allow connection of different kinds of monochrome and color monitors. The various different kinds of local area networks are also supported. The operating system is MS-DOS 3.2. The copious software package contains the major programming languages BASIC, Pascal, C, FORTRAN and COBOL. Other available applications packages are Wordstar, dBASE, Framework, Lotus 1-2-3, Auto-CAD, Ventura, etc.

## Technical Equipment

*23020084 East Berlin RADIO FERNSEHEN ELEKTRONIK in German No 6, Jun 89 pp 361-363*

[Article by W.E. Schlegel: "Leipzig Spring Trade Fair 1989: Effects"]

[Excerpts]

**GDR**

The **VEB Carl Zeiss Combine, Jena**, introduced two new technical systems for cycle 2 in the manufacture of integrated circuits. The manual **MDB 21 wire bonding machine** is the newest version of the MDB 21, and uses the thermo-compression and thermosonic methods. Gold wire with a diameter of 17.2 to 50 µm (100 µm through modification) is used to interconnect the bonding pads on the semiconductor chip and the carrier contacts. Carrier strips with a width of up to 70 mm, substrates measuring 50 mm x 50 mm, hybrid components, flat-pack components and TO-type cans are used as chip packages. The bonder has both manual and automatic modes, and can thus be used equally well for research and development, hybrid and small production lots, and repair work in the manufacturing process. In the automatic mode, only the workpiece is manipulated by hand—placement of the bonding wire and the bonding process itself are automatic. The MDB 21 is a tabletop unit which comprises the following basic elements: baseplate with precision manipulator, bonding unit, stereo microscope, electronic spark generator to form the ball at the end of the bonding wire, and the CMOS controller. Additional elements are the ultrasonic generator and the temperature regulator. The ultrasonic system comprises a two-channel, 60 kHz generator and a piezoelectric system as the oscillator. The bonding tools used are ceramic capillaries 9 or 12 mm long. The chip can be manipulated within an x-y range of 198 mm x 116 mm (coarse) and (8-16) mm x (8-16) mm (fine). The maximum bonding height is 8 mm. The cycle time is given as 0.5 s; the manipulating and bonding times are not specified. The dimensions of the basic unit are 324 mm x 398 mm x 490 mm; the weight, including the ultrasonic generator and the temperature regulator, is 45 kg.

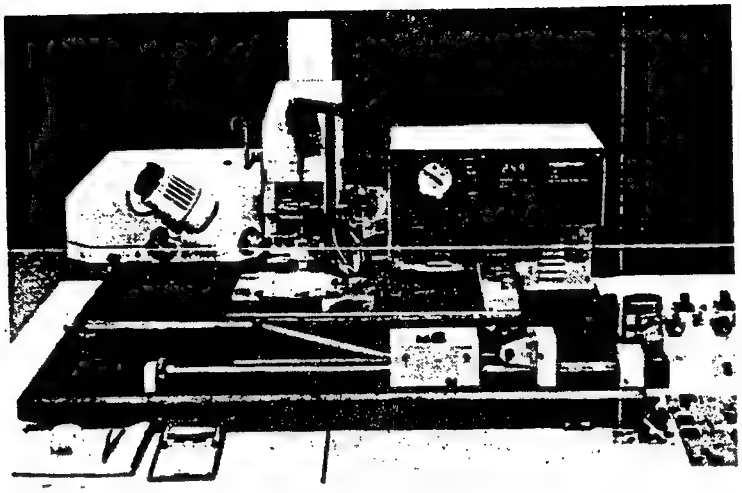

**Figure 8. RaB 10 SMD Repair Station, VEB Robotron-Rationalisierung, Weimar**

The **VADB 20 fully automatic wire bonding machine** is used for wire-bonding integrated circuit chips with gold wire. It processes flat carrier strips, and is intended for large-series production. The operator is guided by a CRT screen, and any faulty bonds are automatically repaired. All drives are electric, and are controlled by a microcomputer (K 1520), which in turn is supported by electrical and optoelectronic sensors. The unit contains an image evaluation system to calculate the positions of the carrier strip, chip and wire. The surfaces of the chip and the carrier appear on a monitor in analog and digital form. The gold wire has a diameter of 17.5 to 50 μm, and is dispensed from a 2-inch roll. The dimensions of the carrier strip are: (100-260) mm x (16-60) mm x (0.15-0.4) mm; the maximum deviations in the position of a 6 mm x 6 mm chip are $\Delta x = 450$ μm, $\Delta y = 350$ μm and $\Delta\varphi = 3°$. Bonding force lies between 0.25 and 3 N, and the bonding area lies within 20 mm x 20 mm. Both bonding machines are made by the **VEB Elektromat, Dresden**.

The **VEB Robotron-Rationalisierung [Robotron Rationalization], Weimar**, introduced the **RaB 10 SMD repair station**. It can be used to populate new printed circuit boards as well as for removing and replacing soldered ICs. Hot air is used for soldering; the repair station can handle SMD components in SO, chip-carrier and flat-pack containers. PC boards to be repaired can be of the plated-through, non-metallized and multilayer type. Their dimensions are (50-320) mm x (50-175) mm. The temperature of the hot air can be

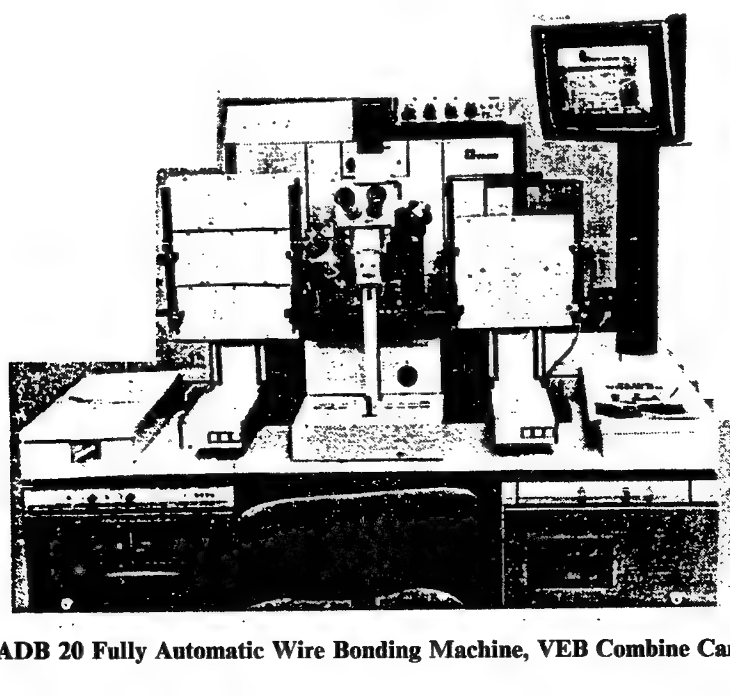

**Figure 9. VADB 20 Fully Automatic Wire Bonding Machine, VEB Combine Carl Zeiss, Jena**

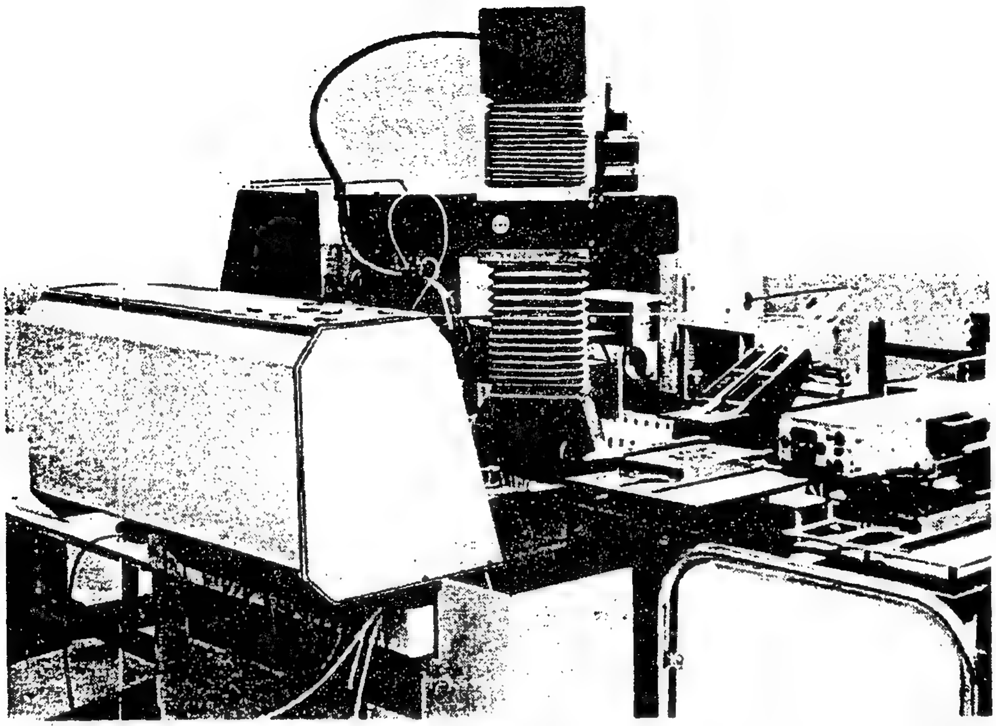

**Figure 10. P 1055 PC Board Populating Robot, VEB Robotron-Rationalisierung, Weimar**

regulated; the maximum temperature is 350°C. The board to be repaired is positioned in 2 mm increments +/-0.2 mm (coarse), and +/-0.05 mm (fine). The components on the PC board can have a maximum height of 13.5 mm; the soldering time is given as 5 to 30 s. The dimensions of the station are 810 mm x 625 mm x 465 mm, and it weighs 40 kg.

The **P 1055 PC board populating robot** handles leadless components, while model **P 1056** is designed for components with leads; both models are intended mainly for small and medium-sized production lots, and require PC boards which can be processed automatically, as well as packaged components (in blister-pack strips or tubular magazines). In addition to integrated circuits (SO 8 through SO 20, CC 18, CC 22 and CC 24), discrete semiconductors (SOD 80, SOT 23, SOT 89 and SOT 143) as well as chip capacitors and resistors can be mounted. The maximum operating speed is 875 components/hour. The component insertion head picks up the components via a vacuum, and uses grippers for centering, with absolutely no mechanical damage to the components. The adhesive is also applied by the robot. Components can be fed to the robot from as many as 45 magazines, depending on requirements, whereby components which are polarity-sensitive must be correctly oriented before they are picked from the magazine. PC boards can be of the plated-through, non plated-through or multilayer type; board dimensions are (60-300) mm x (60-350) mm. The height of the SMDs must not exceed 3.5 mm; in the case of a mixed board population, maximum height is 24.5 mm. Spacing may be in either 1.25 mm or 1.27 mm increments. The robot is controlled by a multiple-processor system using a diskette-based operating system, and the peripherals are controlled by the P 6000.

**Hungary**

The microelectronics company **MEV Budapest** introduced its **Robomat 2000 automatic PC board component insertion device** which is intended for use with SMD components. It operates in an area of 490 mm x 300 mm, and can process up to 2000 components/hour. Placement error is +/-0.1 mm - 1°. The machine can handle chips, Melfs and Minimelfs (with metallized electrode connections), as well as SOT-, SO-, PLCC-, LCCC- and flat-pack containers. The components may come packaged in blister-pack strips, tubular magazines or in trays. The system is programmed on a PS/2-compatible personal computer. The Robomat 2000 is manufactured under a French license.

# TELECOMMUNICATIONS

## GDR: Digital Dispatcher Telephone Exchange Described

*90CW0015A East Berlin NACHRICHTENTECHNIK-ELEKTRONIK in German No 9, Sep 1989 pp 329-332*

[Article by H. Deitert, Chamber of Technology, and S. Mueller, Chamber of Technology, Rochlitz: "Plan for a Digital Dispatcher Telephone Exchange [DFZ] and Product Proposal"]

[Text] 1. Characteristics of Dispatcher Technology

Special telephone systems in non-public networks, characterized by high traffic volume for lines with equal access to or from a particular station, are needed as technical communications equipment in order to control national economic processes and for management tasks. This station (the work place of the dispatcher) must thus perform tasks that differ significantly from those of the switchboard in automatic telephone extension systems. These types of systems are operated manually. The main focus is dispatcher communication with the remote stations, not reciprocal relaying. From this basic task are derived the following functional requirements, which provide meaningful support for the dispatcher activities:

- Radio
- Conferencing
- Dedicated circuits
- Local communication with increased performance level
- Date and time display

### 2. Proposed Plan

#### 2.1. Performance Specifications

The main characteristics noted are met by the dispatcher telephone exchanges (DFZ) that are currently being developed. Startup of production is foreseen for 1990, with plans for the following connection capacities:

- 20 lines (DFZ 20)
- 40 lines (DFZ 40)
- 80 lines (DFZ 80).

The DFZ works according to the principle of the non-patented memory-programmed digital system design used by the NZ 400 D system by VEB Telecommunications Plant in Neustadt-Glewe. The speech circuits are put through in a PCM [pulse-code modulation] switching matrix. A multiprocessor system and special software control all the processes. The systems make it possible to develop networks with two- and four-wire operation for the following types of lines:

- 2-/4-wire ringing lines
- 2-wire central battery subscriber lines
- 2-wire subscriber connection lines
- 2-wire extension connection lines.

The DFZ can work together with the following remote stations:

- 4-wire manual exchanges
- 2-wire local battery exchanges, local battery converters or local battery remote stations
- 2-wire central battery terminals (with and without dialing)
- Extension systems
- Post office exchange equipment.

The energy is supplied by a 60 V system that is not a component of the DFZ. The system is supplied by way of one or two control positions (BP), which can be up to 150-m away from the cabinet. The following operations are available:

- Calls and queries on the dispatcher conversation, relaying
- Interrupting, brokering and breaking connections
- Establishing dedicated connections with permanent allocation of the call unit
- Automatic tape recording of all dispatcher conversations
- Conference connection with max. five call units
- Radio connection with unlimited number of call units, allocation of speaking permission for an additional remote station
- Preprogramming of conference and radio subscribers
- Automatic connection structure for conference/radio
- Touch-tone dialing with ground key and repeat dialing
- Speed dialing: 100 targets, max. 64-digit for 700 numbers
- Display of date and time with stop-watch function and X-time
- Speaking options: hand or head set; alternating communication via loudspeaker and microphone (stationary or remote)
- Acoustic call repeat at the control position
- Call rejection (prevention of acoustic call repeat)
- Night switching (switching off of acoustic call repeat)
- End of call detection (trigger or redial at BP)
- Intercept call unit option; test BP signal equipment
- Display "wrong operation" and dialed number on display
- Redial, servicing, conversation with neighboring station.

#### 2.2. Constructive Design

An EGSI steel cabinet (Figure 1) contains connection and isolation distributors as well as the following exchange equipment:

- Line and subscriber circuits
- Power supply modules (transformer)
- Computer structural components
- PCM components
- Software loading unit.

The operating consoles, designed as dispatcher work stations (Figure 2), consist of the table together with a

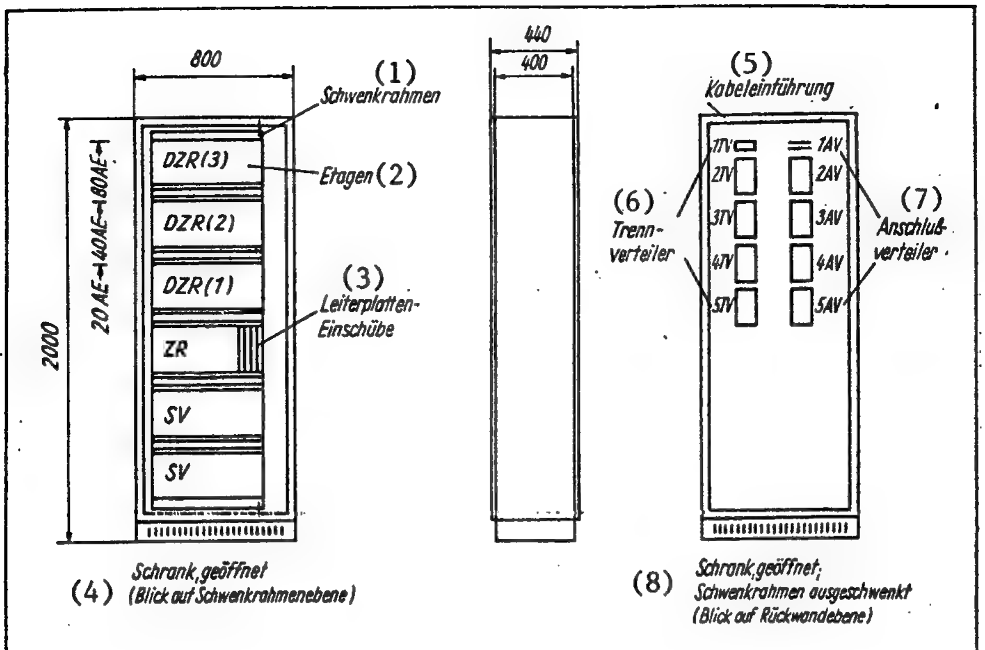


**Figure 1. Cabinet for the DFZ Exchange Equipment**

Key:
1. Rotating frame
2. Levels
3. Plug-in printed circuit board
4. Cabinet, opened (view on rotating frame plane)
5. Cable input
6. Isolation distributors
7. Connection distributors
8. Cabinet, opened; rotating frame swung out (view of rear panel).

lower component and mounted units. The work station, with its connecting units, has the following components:

- Local terminal, control unit, mounted units 1 and 2
- Rerouting unit and variable-gain amplifier
- Ring generator and speaker amplifier
- Control unit and acoustic transducer
- Power supply modules (transformer).

The control unit is a specially designed unit and is connected to the work station with a flexible cord, so that it can be set up in keeping with job requirements. It contains the central control elements, e.g., key pad, conference key, exchange and clear key, and well as their display elements.

The type 1 mounted units (one to four of them, depending on type of system) contain keys and display fields, with which the connected lines can be accessed and their status can be displayed optimally. The type 2 mounted unit features the display for date, time, X times, numbers dialed, and the error display.

### 2.3. Description of the Hardware

The multiprocessor system realized for controlling the DFZ is designed on the basis of the U880 (block diagram, see Figure 3). Control is hierarchical, and comprises central computer (ZR), to which one to three local computers (DZR) and one control computer per operating console (SRBP) are connected. The central computer is also the location of the central devices and connections:

- Software loading unit (cassette or diskette)
- Cross-point module
- Interface between BC [office computer] and PC or FSM [teleprinter]
- End of conversation detector

The ZR monitors the function of the units connected to it and also monitors itself. The subscriber and line circuits (TSOB/ZB, LSSN/TN) are assigned to the local computers (DZR 1, 2, 3). They constitute the link between the analog network and the digital signal processing. The module for realizing conference connections (KONF) and the low-frequency mode adapter (TSPD) for the operating consoles are installed only on the DZR1. The connection between the circuits and the local computer is ensured by the bus of the telecommunications and exchange peripherals (FVTP) for each block. In order to couple the ZR with the DZR, there are two directional eight-bit parallel input and output channels, which are controlled by the corresponding K 1520 bus.

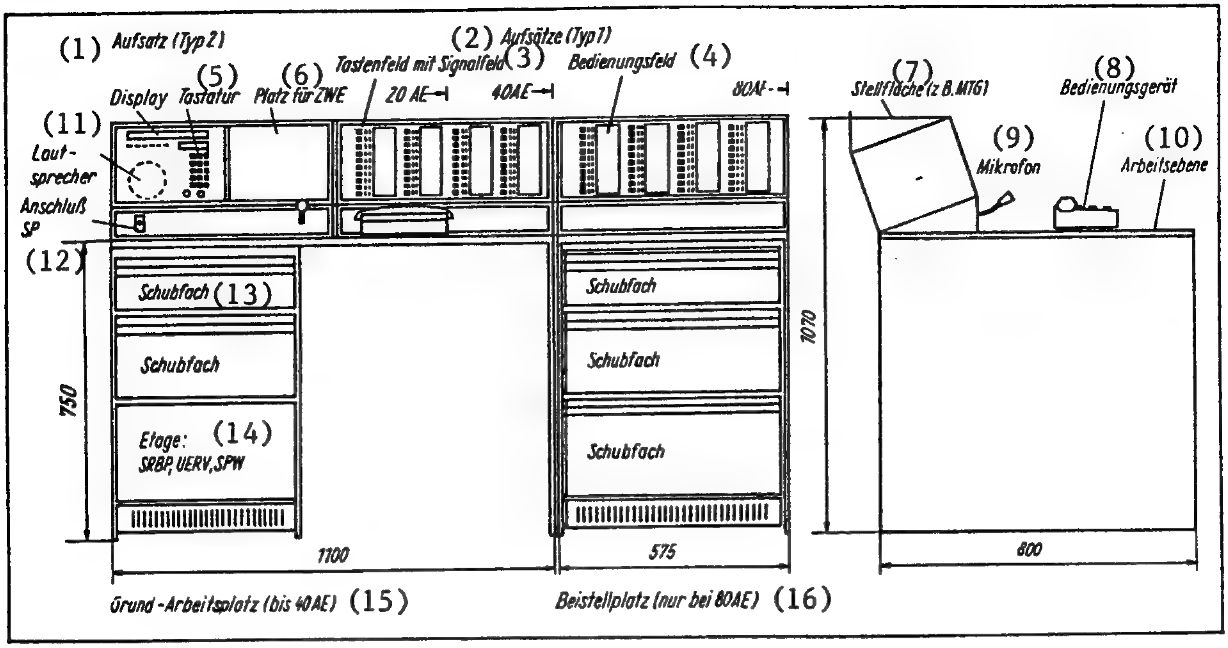


**Figure 2. DFZ Dispatcher Work Station**

Key:
1. Mounted unit (type 2)
2. Mounted units (type 1)
3. Key field with signal field
4. Control field
5. Keyboard
6. Place for target dialing unit
7. Mounting surface (e.g., MTG [magnetic tape unit])
8. Control unit
9. Microphone
10. Working surface
11. Loudspeaker
12. Connection plug
13. Drawer
14. Level: SRBP [control computer], UERV [rerouting unit/variable-gain amplifier], SPW [forward converter]
15. Basic work station (up to 40 AE [connection units])
16. Additional station (only with 80 AE).

**[Boxed item: Acronyms used in Figures 3 and 4]**

| | |
|---|---|
| LGSW | Loader/software |
| AELG | Mode adaptor/loader |
| FSM | Teleprinter |
| BC/PC | Office/personal computer |
| ASID | Connection control, serial interface |
| BP1,BP2 | Operating console 1, 2 |
| SPW | Forward converter |
| SKSV | Switch box, power supply |
| RUGE | Call generator OB/ZB |
| GSER | End of conversation detector |
| KFMZ | Switching matrix, time-distributed |
| ZSSL | Additional control logic |
| DRAM | Dynamic read-only memory |
| ZZRE | Central processing unit |
| ZR | Central computer |
| BKAR | Bus driver and interrupt unit |
| KONF | Conference module |
| SPMT | Multiplexer driver |

**[Boxed item: Acronyms used in Figures 3 and 4] (Continued)**

| | |
|---|---|
| PEAE | Parallel input and output unit |
| DZR | Local computer |
| TSOB | Subscriber circuit OB |
| LSSN | Line circuit, special network |
| TSZB | Subscriber circuit ZB |
| LSTN | Line circuit, subscriber-equivalent |
| LSBK | Line circuit, operating controls |
| TSPD | Subscriber circuit, operating console |
| TSVE | Clock cycle and signal supply |
| SRBP | Control computer, operating console |
| SRA1 | Control computer, mounted unit 1 |
| SRAZ | (read: SRA2) control computer, mounted unit 2 |
| SRBG | Control computer, control unit |
| ZWE | Target dialing unit |
| MTG | Magnetic tape unit |
| UERV | Rerouting unit/variable-gain amplifier |
| RGLV | Ring generator/speaker amplifier |

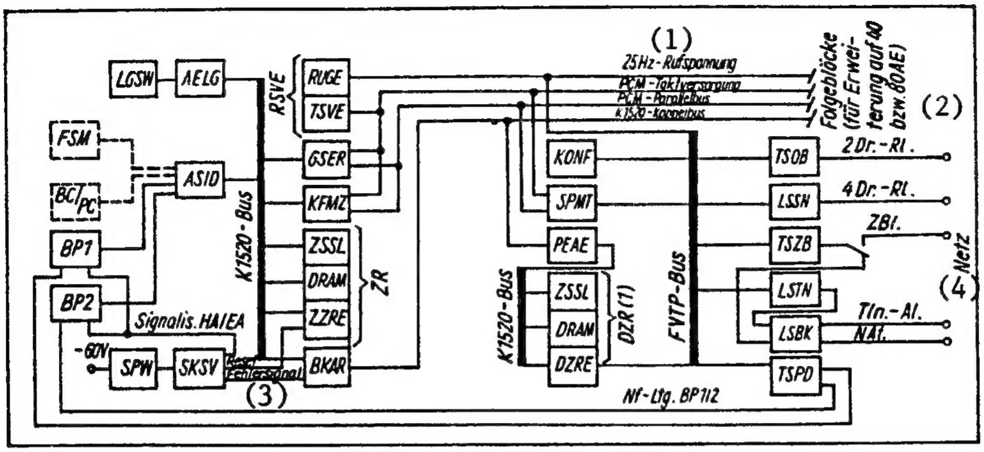

**Figure 3. Block Diagram, DFZ**

Key:
1. Ringing voltage; PCM clock supply; PCM parallel bus; K1520 parallel bus
2. Subsequent blocks (for expansion to 40 or 80 AE
3.Reset, error signal
4. Network

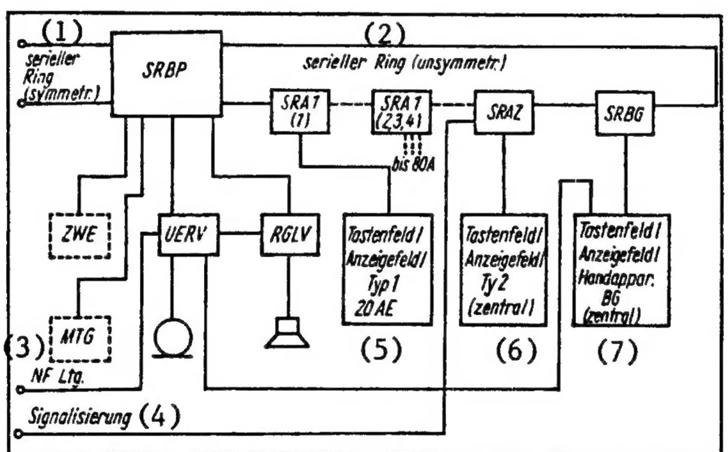

**Figure 4. Block Diagram, DFZ Operating Console**

Key:
1. Serial ring (symmetr.)
2. Serial ring (asymmetr.)
3. Low-frequency line
4. Signalling
5. Key field/display field, type 1, 20 AE
6. Key field/display field, type 2 (central)
7. Key field/display field, hand unit BG (central)

The central calling and signal supply unit (RSVE) provides the call progress tones and ringing voltage as well as the PCM cycles to operate the codec. The clock cycles needed for computer clocking are generated locally. Engaging the operating voltages of the individual modules requires a time regime that is realized by the switching box of the power supply (SKSV).

Communication between the cabinet and the operating console takes place by way of data exchange between the ZR and the control computer (SRBP) by way of a serial, symmetrical ring in each station.

The SRBP functions as a master computer to which slave computers (SRA1/2/BG) are assigned. In contrast to the ZR and DZR, U 8820 single-chip microprocessors are used in all the computers in the operating console (Figure 4). The master computer serves the rerouting unit (UERV) and the ring generator (RGLV) of the acoustic transducer, as well as the target dialing unit and cassette tape unit, if

these peripherals are present. The slave computers, which are integrated by way of an internal serial asymmetrical ring, provide scanning and operation of the display and input units (mounted units, control units)

**2.4. Description of the Software**

**2.4.1. Overview (Figure 5)**

The complex program system consisting of the system program and customer-specific data effects control over the dispatcher telephone exchange with all its performance features. Based on the structure of the hardware, the software can be classified according to the following main areas:

- Central computer
- Local computer
- Operating console

All partial systems contain independent programs that exchange control information via internal communication channels and thus effect the performance level of the overall system.

Since in order to effectively formulate and control complex software systems a strict modularization and structuring of the programs is necessary, the higher programming language PLZ/SYS was used. It provides a language basis in keeping with the demands noted above. In the DFZ, modules are also used in assembler language, although this is exclusively the case for directly hardware-related and/or time-critical problems. The central element of all the main software areas is the RTC real-time system, which organizes the parallel work typical for telephone exchange tasks. The real-time commands necessary for this are defined by the PLZRTC language, which is an extension of PLZ/SYS.

Modularization of the DFZ software is supported by strict separation of unalterable system programs and customer-specific data in the form of the customer module. At the same time, the number of programs is minimized, so that in each case there is only one program of the relevant main area, regardless of the development stage of the DFZ. With the loading process, the partial systems are read into the RAM [random-access memory] of the central computer and in keeping with their type transmitted to all existing components via the internal communication channels. The additionally available customer module then generates the setup for the concrete application.

**2.4.2. Program System of the Central Computer**

Within the DFZ, the central computer occupies a special position. Its program performs the function of a coordinator and central manager. All tasks that have a transcending character—i.e., affect several components of the overall system—pass through the ZR.

This includes:

Controlling exchange functions:

- Status control of connection units
- Time slot management
- Switching matrix control

Communication with intelligent DFZ components:

- Local computers
- Operating consoles
- End of conversation detection
- Monitoring of the DFZ hardware
- Service communication via teleprinter or service computer (IFSS)

In order to achieve optimal transparency, the ZR works together with all intelligent components on a logical level. In this way, independence from the concrete hardware in the individual components is achieved.

**2.4.3. Local Computer Program System**

The tasks of the local computers can be characterized as intelligent processing of the telecommunications environment:

- Scanning and outputting identifiers from or to the subscriber and/or line circuits
- Time slot programming for the codecs
- Self-monitoring

The points noted show the main idea behind the DZR software, which is to convert logical ZR commands to the concrete physical level of the line and subscriber circuits and vice versa. Consequently, the principle of hierarchical structuring and decentralization is maintained. In this way, data exchange with the ZR is minimized and reduced to problems of managing the circuits.

**2.4.4. Program System of the Operating Console**

In contrast to the hardware components in the cabinet, the hardware at the operating console deviates sharply. The individual components are connected by a serial ring through application of the ZR. Data exchange on the ring is based on the token principle. While the slave computers contain only a minimal program to operate the serial ring, the keys, and the lamps, the master computer is equipped with a complex program system. Based on positive experiences using a special real-time operating system (RTC) in the ZR and DZR, a real-time core with the functional size of the RTC U880 was designed and implemented for the single-chip microprocessor. The main tasks of the master computer are:

- Conversion of the physical key addresses transmitted from the component computers into logical key codes
- Conversion of the logical lamp codes transmitted from the ZR into physical addresses for the components
- Realization of station-internal functions

As in the design of the DZR, hierarchical decentralization is clear here.

With the customer module, the DFZ software is adapted to the concrete application in question. This data

module, which is loaded at the end, is the only part of the total DFZ software package that differs in accordance with the respective stage of development and the properties of the associated application. It remains in the memory of the ZR as a resident work area. Necessary information for the DZR is transmitted during the initialization phase.

The loaded customer module is accessed only by way of references. In this way, both parts of the software (unalterable system program, customer module) can be processed independently. By maintaining the structure of these customer-specific data, it is possible on the one hand to implement changed versions of the system programs at the application site in the short term and on

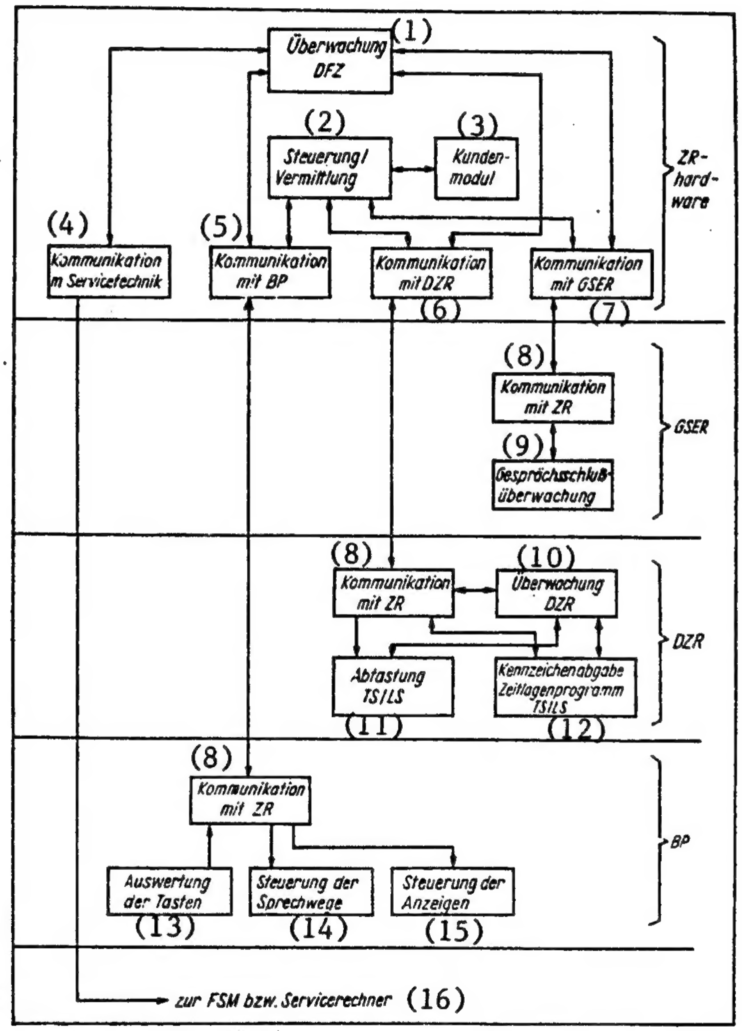


**Figure 5. Software Components of the DFZ (With DZR, Lower Right Box—Time Slot Programming)**

Key:
1. DFZ monitoring
2. Control/exchange
3. Customer module
4. Communication with service technology
5. Communication with BP
6. Communication with DZR
7. Communication with GSER
8. Communication with ZR
9. End of conservation detection
10. DZR monitoring
11. Subscriber/line circuit scanning
12. Identifier output, time slot program, subscriber/line circuit
13. Evaluation of keys
14. Control of voice paths
15. Control of displays
16. To the FSM or service computer

the other hand to easily work on demands resulting from changes in the telecommunications environment via the customer module.

Using a questionnaire, the project leader should determine which call key at the operating console should be assigned to which connection line and in which operational mode they should be worked. In order to effectively formulate new customer modules, a service program to that effect is being prepared, which can be run on the available PC and AC technology and allows menu-supported reformulation of and changes in customer modules.

### 3. Functional Principle

After the system is turned on and the basic initialization is conducted by the loading routine of the ZR (EPROM) by way of the mode adaptor (AELG) of the software loader (LGSW), in which the data medium (cassette or diskette, depending on the type of loader) with the control software is found, the system is ready for operation.

When an identifier from the network is detected, the assigned line circuit is considered occupied. By cyclical scanning of all circuits, the DZR recognizes the occupancy. In the DZR, circuit identification is followed by message preparation with address identification and by way of the PEAE and BKAR acceptance of the message by the ZR. The ZR causes a control word to be sent via the ASID to the token ring at the operating console. The control computer SRBP at the operating console evaluates the control word and sends it, recoded, to the internal ring in the slave computers. Each computer checks whether the control word concerns it. If it does, it is evaluated and recoded in order to handle acoustic and optical call signalling. Otherwise, the computer sends the control word to the next computer unchanged. By pressing the line-specific key, the console is connected to the calling line through a corresponding data exchange between the computers.

In the line circuit (e.g., LSSN), the low-frequency signal arriving through the line is recoded into a PCM signal and sent on the PCM highway in a time slot programmed by DZR and issued by ZR. The voice connection between the station and the remote station is switched by assigning time slots of the circuits to be connected in the switching matrix. Since time slots with separate directions are used, the digital coupler principle realizes a quasi-four-wire switching. The TSPD converts the received PCM signals back into low-frequency signals, which then reach the console by way of the low-frequency lines. The transmission in the direction of the line takes place in an analogous fashion.

In this mode, the dispatcher can either exchange information directly with the calling remote station or cause other action through control operations.

### 4. Summary

With the development and production startup of DFZ-type systems, the preconditions for the development of special dispatcher networks are present. The application of various circuits as the interface to the network makes it possible to cooperate with other equipment and system via standard line types and with their transmission processes. By applying a modern digital system design with a continuous multiprocessor system, a high degree of flexibility and a high level of automation are achieved to support control operations.

### Literature

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